Gov. Doc
Ont
H

Ont Hydro Electric Power Comm.
Hydro News.

CA2ONEP
-H95

3 1761 11892221 0

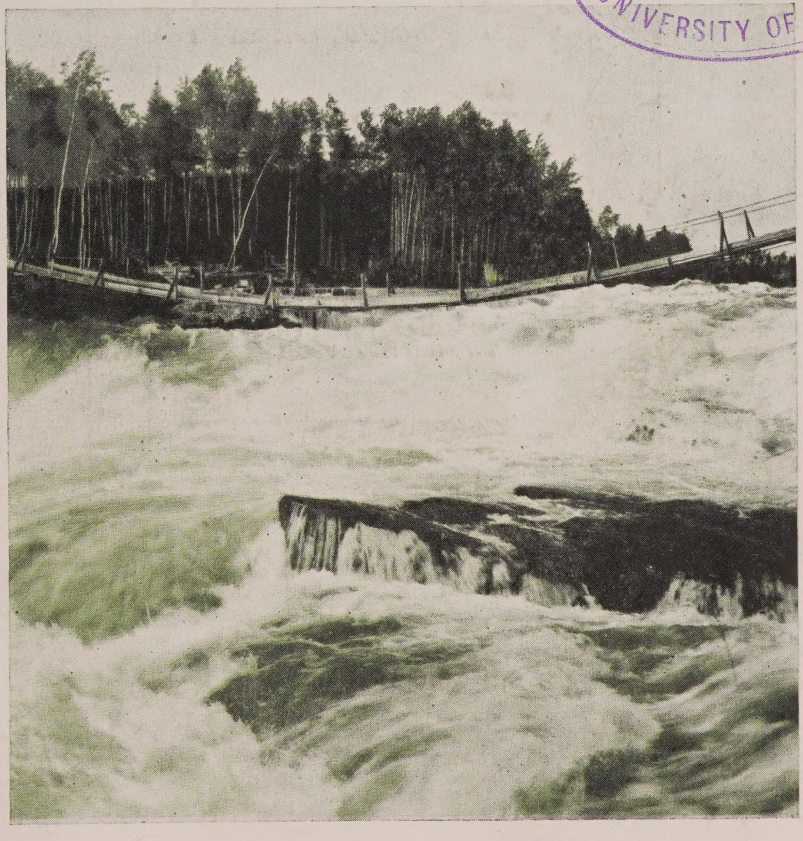
THE BULLETIN

Vol. VII. No. 5

Hydro-Electric Power Commission of Ontario

JULY 1920

LIBRARY
UNIVERSITY OF TORONTO



Cameron Falls, Nipigon River

THE BULLETIN

PUBLISHED MONTHLY BY THE

Hydro-Electric Power Commission of Ontario

ADMINISTRATION BUILDING
190 UNIVERSITY AVE.
TORONTO

SUBSCRIPTION PRICE:
TWO DOLLARS PER YEAR

CONTENTS

VOL. VII. No. 5
JULY, 1920

Association of Municipal Electrical Utilities

Minutes of Convention at the Clifton Hotel, Niagara Falls, Ont., June 10 and 11, 1920

FIRST SESSION.

The meeting was called to order at 2.30 P.M. by Mr. O. H. Scott, President of the Association, who addressed to the Convention a few words of welcome.

Moved by Mr. P. B. Yates, seconded by Mr. H. F. Shearer: That the minutes of the previous meeting be taken as read.—*Carried.*

The Secretary then read his report regarding the membership of the Association. Moved by Mr. O. M. Perry, seconded by Mr. H. E. Timmerman: That the following names be added to the list of Associates:—D. T. Flannery, M. McKenzie, A. W. Murdock, P. A. Borden, A. G. Hall.—*Carried.*

Also that the following Companies be admitted to Commercial Membership:—Canadian Edison Appliance Co. Limited, Chas. A. Branston Co., W. A. Kribs Co. Limited, Lincoln Electric Co. of Canada Limited, The Lyons Electric Co., National Engineering Co. Limited, O. H. Pierce, Swedish General Electric Limited, A. H. Winter-Joyner, Limited—*Carried.*

The Treasurer reported a balance of cash on hand of $1,369.64.

Mr. M. A. Mackenzie, Professor of Mathematics, University of Toronto, read a paper entitled "Sick Benefits and Pension Systems." Discussion on this paper was by: Messrs. V. S. McIntyre, John Taylor, J. W. Purcell, R. C. McCollum, H. C. Powell, D. Phelan, A. T. Hicks, C. E. Schwenger, H. T. Gibbs, J. E. Coombs, H. F. Shearer, and O. H. Scott, President.

A very hearty vote of thanks was extended to Professor Mackenzie for his excellent paper.

Mr. A. T. Hicks, Chairman of the Regulations and Standards Committee presented his report in reference to the Standardization of Plugs and Receptacles.

Moved by Mr. A. T. Hicks, seconded by Mr. R. H. Staford:—That the report of the Regulations and Standards Committee be adopted.—*Carried.*

Mr. O. M. Perry, Chairman of the Special Committee, appointed to report on the rates for electric ranges, presented his report.

Moved by Mr. P. B. Yates, seconded by C. A. Walters:—That the report as presented by Mr. Perry be adopted, and that the Executive be authorized to take the matter up with the Hydro-Electric Power Commission of Ontario, for its approval.—*Carried.*

Two baskets were placed in the hands of Mr. A. T. Hicks as a present to his bride from the Association.

The meeting adjourned at 5.30 P.M.

The Association met at 6.30 P.M. for dinner at The Clifton, when it was addressed by Major W. W. Pope, Secretary, Hydro-Electric Power Commission of Ontario.

SECOND SESSION.

The meeting resumed at 10 A.M. June 11th, 1920.

Mr. J. G. Mickler, Assistant Auditor, Municipal Accounts, Hydro-Electric Power Commission of Ontario, read his paper entitled, "Merchandise Accounting for Hydro Municipalities."

Discussion on this paper was by: Messrs. H. P. L. Hillman, G. W. Blay, John Taylor, R. C. McCollum, A. W. J. Stewart, G. H. Clarke, R. E. Garrett, H. F. Shearer, A. T. Hicks, J. G. Jackson and O. H. Scott, President.

The meeting adjourned at 12 noon.

THIRD SESSION.

The meeting resumed at 2.30 P.M.

Mr. M. J. McHenry presented a report in reference to the work of the Central Accident Prevention Committee.

Moved by Mr. McHenry, seconded by Mr. H. O. Fisk: That the report as presented be adopted and also the resolution.—*Carried.*

Moved by Mr. H. O. Fisk, seconded by Mr. V. B. Coleman: That the present representation of this Association on the Central Accident Prevention Committee be retained.—*Carried.*

In reference to amendments to the Constitution and By-Laws, it was:

Moved by Mr. H. F. Shearer, seconded by Mr. F. C. Adsett: That the words "Class A," be deleted from the third line of Section 8, Clause b, and the words "Chairmen of Committees" be inserted instead, making the clause read:

"The presiding officer at this meeting (President or Vice-President) shall select from the Chairmen of Committees present, three men to act as a Slate or Striking Committee, who shall————."

Mr. P. M. Lincoln, Lincoln Electric Co., Cleveland, Ohio, read his paper entitled "Metering the Consumer's Load." Discussion on this paper was by: Messrs. R. G. Lee, P. A. Borden, O. M. Perry, R. T. Jeffery.

The Association extended to Mr. Lincoln, a hearty vote of thanks for his interesting and instructive talk, and also to Mr. Mickler for the paper presented by him at the former session.

There being no further business the meeting adjourned at 4.45 P.M.

The register shows a very satisfactory attendance at this Convention, the representation being as follows:

Class "A"	73
Class "B"	26
Associate	33
Commercial	76
Guests	9
Total	217

Sick Benefits and Pension Systems

By M. A. Mackenzie, M.A.
Professor of Mathematics, University of Toronto

THE attention recently given to Sick Benefit Funds and Pension Systems throughout North America marks an interesting change, full of possibilties, in the development of industrial life. If, during the coming years, many of these funds are carefully watched and protected and the Pension Systems that are being introduced should be laid down upon sound lines and kept upon those lines, there will develop an influence of great value in the improvement of relations between employers and employees because such systems tend to promote steadiness and permanency of employment. If, however, the funds should be indifferently managed or the systems promoted upon unsound lines, they will inevitably lead to discontent and must either collapse or be painfully reconstructed in the face of suspicion and amid charges of bad faith.

After all, these things are not new. We have a long history to guide us. Sick Benefit Systems existed in the Thirteenth Century in England and also upon the continent. The Guilds, as they were called, in which such funds developed were generally purely local, sometimes connected with a special branch of industry. They granted benefits in case of sickness, poverty and old age, damage by fire, water or thieves. Some provided relief in case a member were cast into prison and some even provided dowries for daughters. Death benefits were generally provided by a special levy on the survivors. These old Guilds are so interesting that it may be worth while to read an extract from the rules of one of them. The following is taken from the Statutes of the Guild of Smiths in Chesterfield:

"When a brother is ill and needs relief, then he shall receive half a dime daily; when brethren fall into poverty then they shall go singly on certain days in to the houses of their brethren where each one shall be received civilly, and he shall obtain whatsoever he may need in the shape of food and clothing, as if he were the master of the house himself, and he shall also receive half a dime like those who are ill, and then he shall go his way in peace."

Brotherhood is no new thing.

These Guilds were independent of the masters. They were self-supporting, each member contributing to the common fund. Sometimes the contributions were equal, sometimes they were graduated according to the wealth of the member like a modern income tax. In some trades membership was compulsory upon every employee, in others the voluntary system obtained. Hundreds of these organizations were created during the middle ages, most of them with the best intentions and most of them on impossible lines. Hundreds of them collapsed to be followed by hundreds more, but during the centuries the lessons of sound management were being painfully learned and the un-

derlying principles of all such organizations were becoming apparent. It was only in the latter part of the Nineteenth Century, after the industrial revolution and the growth of large corporations, that the employers took an interest in such funds and began to contribute to them. At present there are many Sick Benefit Funds and Pension Systems in England among the railways, manufacturers, trading companies and other large Corporations. There have been similar funds for such relief and for pensions in North America, but the great opportunities offered to new settlers and the enormous natural wealth of this continent left little room or need for the development of such funds. It is only in comparatively recent times that industrial conditions in North America have forced us to attack the problems of incapacity and old age, and being North Americans we know very little of European history. We are convinced that our problems are peculiar to ourselves and we dash at them with energy, courage and ignorance that are all unbounded.

If we look into these problems a little more closely we will find that insurance against sickness is like insurance against fire—a mere contract of indemnity. If a fire occurs, the insured has a claim. If no fire occurs, the insured has no claim. No matter how many years a man may have paid premiums to a fire office, he never imagines that he has a claim against that office unless and until a fire occurs. This is analogous to insurance against sickness. No man has any claim upon the sick benefit fund until and unless he is sick. On the other hand insurance against death is not a contract of indemnity at all. It is a guarantee of a definite payment that is certain to be made at some time in the future in consideration of certain definite periodical payments called premiums to be made by the insured in the meantime. Thus the sick claims of each year can properly be met out of the income of that year. No special fund need be built up for each man to provide for the future sicknesses of that man. On the other hand, if a man is insured against death and especially if that insurance be combined with the right to a pension should he survive, a fund should be built up every year out of his premiums so that provision may be made for a claim that is bound to arise. Thus the finances of a sick benefit fund are on an entirely different basis from the funds of a death benefit and pension fund.

Let us deal first with Sick Benefits. Now sicknesses from our point of view may be divided into:

Those resulting from injury which arose in the discharge of duty, and

Those which are independent of any such connexion.

The Workmen's Compensation Act has to a large extent removed the first from our consideration. It is sickness of the second class which is to be provided for by a sick benefit fund. Now if all men were honest and no men were shirkers, our problem would be easy. It is true that the rates of sickness vary in different occupations and among different classes of men, but each organization would soon find its own requirements and, keeping a margin for contingen-

cies, could strike and maintain a rate appropriate to the benefits. Unfortunately, however, there are a few men in every community who fall below the common standards of honesty and when such men become members of a sick benefit association they try "to beat the system." Safeguards have therefore to be introduced in various ways.

By Medical Examination.

This provision is generally regarded as essential, but examination by the applicant's own physician cannot be regarded as satisfactory. The medical profession is neither infallible nor are all its members incorruptible. The selection of the physician is of vital importance and periodical examinations and reports in cases of prolonged sickness are essential.

By Limiting the Time During Which Benefits May be Enjoyed.

This safeguard is also generally adopted. A common method is to grant full sick pay for a limited number of weeks of sickness to be followed by decreasing fractions of full sick pay for subsequent periods of continued sickness. Another method is to allow so many days of sick pay each year. When the number of days so allowed is small then there is also sometimes a provision that credits for sick pay may accumulate, so that a man who serves nine years without an illness may have the right to ten times the annual allowance of days on sick pay in his tenth year should he then fall ill.

By Limiting The Age Up To Which Members Are Entitled To Sick Pay

As men grow older sicknesses become more frequent and tend to become chronic. Nor is it always easy to distinguish between sickness and the infirmity of age. Of course, if the sick benefit is operated in connexion with a pension scheme, sickness will not be considered after a pension has been granted, but even if there are no pensions it will be found necessary to fix a limiting age beyond which sick pay may not be claimed.

But the most important safeguards are those that are least recognized and most difficult of adoption. They are, first,

The Placing of Some Part of the Financial Burden Directly Upon the Employees

themselves by means of regular contributions to the fund. When this is done the men have a personal interest in preventing malingering, and human nature is such that many men who would not hesitate to "put one over" on the company would yet scorn to benefit directly at the expense of their fellow employees. Second and most important of all, the best safeguard consists in

Limiting the Sick Pay

to such a fraction of the active pay as will not put a premium upon dishonesty. It is a remarkable fact that sickness rates are generally highest in those associations where sick pay is highest and lowest in those where the sick pay is low.

The practical problem of sick benefits therefore resolves itself into a

problem of drafting the regulations so as to reduce dishonesty to a minimum, and carrying out these regulations strictly, without at the same time lowering the benefits too much for the honest man who will always be in the majority and for whose protection the system exists.

Coming now to the much more difficult problem of pensions—pensions upon invalidity, of course, need safeguarding even more carefully than sick benefits, because the cost of such pensions is much greater than the cost of temporary sick pay. All pensions, whether upon invalidity or upon old age, have an appearance of simplicity that is quite deceptive. We hear of the adoption of pension systems by one corporation after another—great, strong corporations that surely must know what they are doing. We write to such corporations and obtain details of their newly adopted plans and from these details we construct a plan for our own corporation. But we do not get particulars from plans that have been half a century or even a quarter of a century in operation. Now the history of nearly all such funds is the same. At the outset the payments to pensioners are a small charge, a very small fraction of the total pay roll, so they are included among the expenses and met as they arise. Each year, however, adds to the pension list, and though some pensioners die, the total number of pensioners continues to grow. Two facts have been overlooked. The men who had been long in the employ of the corporation when the system was started were the survivors of the smaller staff of many years ago when the corporation was young. Also when the system was started no consideration was given to the fact that a number of old servants were still living who had retired without pensions before the system was adopted. Consideration of these facts shows why the pension list will continue to grow year after year until it has reached a very large percentage of the pay roll. In the customs and treasury departments of the British Civil Service the pension payments in 1902 amounted to 30 per cent. of the active pay roll of these departments. That pension plan had been in operation for nearly a century and the staff in those departments had not been an increasing one for many years. No ordinary corporation could stand such charges. When the pension payments have grown to 10 per cent. or 15 per cent. of the pay roll they become a serious drain upon the resources of an ordinary corporation and attempts are made, especially in times of financial pressure to check this drain which shows no signs of checking itself. Such attempts are met by the fact of vested interests. The employees at once advance the plea—you promised us pensions. We remained in the service in full expectation of those pensions. Had we not had that hope we would have left the service and bettered ourselves long ago. Now we are too old to move and you propose to break the promise in which we have trusted. The plea is unanswerable. It certainly is not answered by pointing to a clause in the regulations which states that "nothing herein contained shall give any employee a contractual right to a pension." That may be a legal an-

swer, but every employer of labor knows that it is not a practical one. Even if no attempt is made to evade the promised pensions, the employer will find sooner or later that the employees refuse to regard the pensions as benevolent grants for long and faithful service, but will insist upon regarding them as something which the employees have earned and to which they have a right. "Deferred pay" is the expression used and it represents a fixed idea. In a pension system which has been some years in operation, the employees will regard their pay as so much cash and so much credit toward a pension. I fancy that if all these things had been foreseen most of the pension systems in operation would never have been created.

In January of 1916, the State of Illinois appointed a Commission to investigate pension systems. Three years later the governor of the state in his message to the Illinois General Assembly said: "the commission has found that nearly all, if not all, of the several pension funds created by the different municipalities, as well as by the state itself, are hopelessly insolvent." The same remark could be made regarding many, if not most, of the pension systems in existence in North America. This sounds very dreadful and very pessimistic, but the commission which found this condition has also carefully pointed out the errors and ill-advised beginnings which created it. Moreover, the commission fully realizes the need of pension funds as a necessary part of our social machinery and has elaborated standard plans for sound and satisfactory pension systems. All the evils that have arisen have been due to lack of foresight and unwillingness to learn from the experience of others. The benefits of a pension plan can be secured and the plan made permanently solvent if the initial difficulties are fairly faced and the plan prepared upon actuarial principles.

Let us now consider what are the objects sought by a pension plan and how these objects can best be obtained. First, what are the objects sought by the employer? They are

The Elimination of the Unfit.

In most old services there are men who are kept upon the pay roll so long as they can put in an appearance at the office or shop. These men ought to be superannuated. They retard the business and they clog the avenues of promotion, but if they have no other means of support, it is very difficult for the management to get rid of them. In a government or municipal service they become a very serious menace to efficiency.

The Retention in the Service

of the best men who might otherwise be attracted by higher cash offers elsewhere. The capable man of fifty who knows that he will be able to retire on a pension at sixty five if he remains in the service will hardly be attracted even by a 20 per cent. increase in salary from some other employer.

The Attraction Into the Service

of a more thoughful type of man who appreciates the advantages offered by the pension plan.

Next, what are the objects sought by the employees? A little consideration will show that here we have

divergent interests. The older employees simply desire a pension toward which they have made and can make no comparable contributions. They are generally not interested in the case of the young man with a growing family who may become disabled or die while the family is young. They have themselves escaped these dangers. They are thinking mainly of their own old age. They base their claim upon long and faithful service —"the heat and burden of the day"— and to them the pension is a benevolent gratuity. On the other hand the younger men in the service and the men who are about to enter the service will not regard the pension plan in this light. They argue that the employee earns all he gets and the system contains for them no element of benevolence. They look upon the benefits not as gifts but as a part of their wages and they insist that these benefits should be designed to meet the risks of the whole life of service, not merely the risk of poverty in old age. The benefits they desire, therefore, are:—

A Payment on Death

before reaching the pension age.

A Pension on Disability

before reaching the pension age.

Compensation For Loss of Rights

on dismissal or voluntary resignation, and

A Pension on Old Age

not primarily for themselves, they are too young to think of that, but because such pensions will keep open the avenues of promotion.

The future of the corporation lies with its younger men and it is unfortunate that the broader outlook which they possess should be ignored by the employer who usually consults only the older men in the preparation of a pension plan. Generally speaking it may be said that the objects sought by the younger men and by the employer are identical and tend to the permanent improvement of the service.

Now that we have considered the benefits, let us see how they are to be provided. These things cost money. How is the money to be raised? The first and most obvious plan that suggests itself is to contribute a percentage of the wages or salary total just sufficient to make the pension payments year by year. In other words, to regard pension payments as being part of the expenses of the year in which they fall to be made. I have already referred to this plan and so far as I know it has never stood the test of time except in the case of the civil servants of a great government —Great Britain for example. Even with great governments the plan has failed. We all know of its failure at Ottawa. It has also failed in Australia, in New Zealand and at the Cape. It has failed in New York and Chicago with teachers, policemen and firemen. It has failed in similar cases nearer home. Indeed the list of failures is a long one.

What is the alternative? It is to regard the benefits of the system as insurance benefits are regarded, to ascertain the proper cost premiums for each age at entry, to collect these cost premiums, to accumulate them as a reserve for the benefit of those on whose behalf they are paid and not to pay any benefit to any man unless the

cost premiums for that benefit have been collected in respect of that man.

If from the commencement of a service every man had paid the premium proper to his age at entry, there would be no trouble at all. The troubles arise because when a pension fund is started there are a number of middle-aged and even some old men in the service and no premiums have been collected and accumulated in respect of their previous years of service. If, for example, we have found that a level premium amounting to five per cent. of salary as from age at entry into service will provide the benefits, it is obvious that the future five per cents of these older men will not provide the same benefits as the future five per cents of a young man just entering the service. There is an accrued liability in respect of these men and that accrued liability must be ascertained and met as far as possible. If it cannot be met in full, then these older men cannot obtain full benefits. It will not do to pay benefits to older men out of the premiums collected from or in respect of the younger men. That will simply defer and accumulate the deficit and will end later on in disaster.

We must now consider the question of who should pay the premiums. The usual but by no means the invariable practice among modern pension funds is to ask for no contribution from the employees. Some industrial and more municipal corporations, however, demand that the employees pay some part—usually a half—of the premiums. In my opinion it makes very little difference in the long run whether the young employee just entering the service pays a share of the premium or not. The employer who forces his staff to contribute will be himself forced to increase wages above the competitive wages paid by another employer who has an equivalent pension plan for which he makes no deduction from wages. It will probably be found easier to create the plan if the employer nominally assumes all the cost. On the other hand when the employee is paying directly in cash a part of the cost himself, the pension plan is on a more secure foundation and the employee will be able to claim a share in the management, while the employer will find that he cannot make changes in the system without the consent of the employees. The essential point is that the pension benefits must be regarded as part of the remuneration for services and the premiums which produce these benefits are therefore part of the wages, whether they be paid as direct contributions out of a larger cash wage or as indirect contributions by the acceptance of a smaller cash wage. That is, in my opinion, the foundation stone of a permanent pension system. When it is clearly recognized that the remuneration of the employee consists partly of a cash wage and partly of a deferred wage to provide pension fund benefits we are on solid ground. This principle has received the highest endorsation—it was recognized by the Imperial Parliament of Great Britain in the Pensions Act of 1909 and has been endorsed by most modern writers upon the subject.

How then are we to deal with the cases of the older employees who are in the service when the system is to be started? Some of these men are

at such advanced ages that the proper cost premiums in their cases would approach or even exceed the whole of their wages. They cannot be asked to meet these premiums themselves directly or indirectly. The fact is that the pension system should be considered and the benefits decided upon and the premium rates ascertained without regard to the present employees. The whole scheme should be devised with a view to improve the service in respect of the men who will thereafter enter the service. When that has been done the corporation should consider the cases of the men now in the service and give them, as an act of benevolence, such a sum as will, together with the future premiums on their behalf, provide the benefits to which they may become entitled. The future premiums of the younger men among them will leave a comparatively small liability to be provided for, but the future premiums of the older men will leave a very large liability. It is a fortunate corporation that can meet this accrued liability in full. Generally it will be found that the older men can not be granted the full benefits. In any event they will be much better off than the men who left the service before the pension system was adopted.

This may sound very unsympathetic to old employees. Such men make a strong plea to our humanity. There are not many of them. Surely we can afford to pension them? Their little pensions look pitifully small compared to the total revenue and the temptation to deal with the matter on a revenue basis is very strong, but I am convinced that any pension plan drawn up with the idea of treating old men on this basis will, ultimately collapse. It is the fallacy which has wrecked so many fraternal insurance schemes. Death claims and pension payments cannot be regarded as current expenses to be ignored until they arise. All such payments that may ever occur in the future to every member of the staff must be regarded as "bills payable" and must be taken into the balance sheet at their discounted value on the date of that balance sheet and there must be assets to offset them. In short, pension systems are a serious undertaking. We must have business principles as well as benevolent instincts.

I seem to have harped upon principles and neglected interesting details. The whole question is so intricate and involved that it is very easy to get lost in details. There are many of them to which I have only referred in passing or which I have omitted altogether. I have not dwelt upon the fairly obvious conclusion that the corporation which adopts a pension system must recruit its staff from young men, nor have I referred to the difference between the requirements of the office staff and those of the factory or field staff, or to the difference between the attitude of male and female employees toward any pension plan or to the question of widows' pensions, or the relation between the main benefit—the pension—and such subsidiary benefits as life insurance or payments on dismissal, also I have made no reference to the question of management or the investment of the funds. For all these omissions I crave pardon, pleading that the time at my disposal was short and that I

was anxious to establish the fundamental principles in the light of which so many of these details must be considered. If those principles are accepted, it will be easy to work out the details. If they are not accepted there is nothing to which we can relate the details.

References:—

The Journal of the Institute of Actuaries.

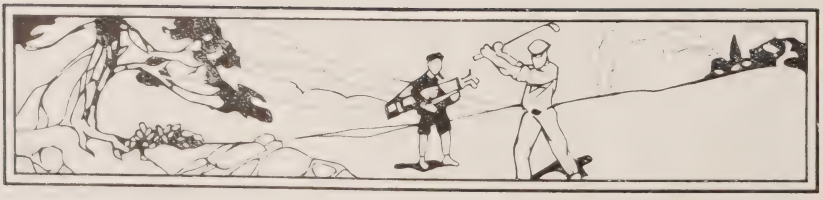
Proceedings of the Actuarial Society of America.

Report of Massachusetts Commission on Pensions, 1914.

U.S.A. Senate Document 290—61st Congress, 2nd Session.

Report of Illinois Pension Law Commission, 1918-19.

Principles Governing Retirement of Public Employees, by Lewis Meriam, 1918.



Discussion Following Professor Mackenzie's Paper

Mr. V. S. McIntyre (Kitchener): This is a question that has been before the Association for three years and I am very glad that we finally succeeded in getting a paper delivered to our convention, and I think we are very much indebted to Professor Mackenzie for his talk.

So far as a sick benefits plan is concerned, it is an easy matter for many corporations to deal with. You can get sick benefit insurance on employees for $5 a year which covers practically any sickness. So far as pensions is concerned, that is another proposition, and while listening to Professor Mackenzie it just occurred to me if it wasn't possible for the Government to appoint a Board along the lines of the Workmen's Compensation Board and take up this question of pensions in connection with industries, particularly the electrical industry. We have seen the work of the Government and I don't think they would have any difficulty in working out a pension scheme.

There is no doubt where a corporation has a pension scheme, their labor costs are considerably lower. I know we compete with the Grand Trunk Railway for labor in Kitchener and their labor is thirty per cent. lower than the labor in our industry. The simple reason is that the employees on this road are going to indulge in these pension benefits when they reach a certain age. I think this policy also works out to obtaining a more efficient labor from the employees. The old employees give you at least thirty per cent. more efficiency than the employee that you hire to-day and who is gone to-morrow.

I think it is a question that should be taken up by a Board and worked out in the same manner as the Workmen's Compensation scheme. When they started that idea everybody went up in the air but it has worked out all right.

Mr. J. W. Purcell, (H. E. P. C.). May I ask Mr. Mackenzie if he is familiar with the steps taken by European Governments in this connection ? whether he knows that two or three of the European Governments two years prior to the war appointed Commissions to investigate the question of pensions? I think I remember reading in a publication that has a digest of different pension schemes used abroad in connection with commercial enterprises, that there were Pension Commissions appointed in England, Germany and France and some of the other European countries in 1914. I don't remember the details of what those Commissions had done or whether they had actually reported prior to the war. I do remember distinctly such Commissions being appointed in at least three countries. I rather think that Mr. Barnes on our staff could give some information in connection with what these Pension Boards have done.

Mr. John Taylor (Hanover): As Professor Mackenzie was going along I wondered why this paper was put on. I am an entire stranger to you, this being the first time I have been here. I would like to know if there is a pension scheme already adopted

by the Hydro-Electric Power Commission of Ontario, or is the object in view to start that kind of a scheme with the Hydro-Electric Power Commission? I would also like to know how such a scheme would affect the local Commissions? Would they be supposed to join along, or is this just an initiative project to bring the matter before the Government with the idea of having such a pension scheme, or something of that kind started? I would like to know how far we have advanced in this matter or what there is at the present time.

THE PRESIDENT: Mr. Taylor, in replying to your questions, this Association has for some time felt that the Commission should undertake some form of sick benefit or pension scheme, and we have been endeavoring during my three years on the Executive to get somebody to tell us what they knew about these schemes so that we could form our opinions.

MR. TAYLOR: Then nothing has been done so far; you haven't arrived at any basis or no authority has been given?

THE PRESIDENT: So far as my knowledge goes, no.

MR. TAYLOR: This is just a projective scheme?

THE PRESIDENT: Yes.

MR. R. C. MCCOLLUM (H.E.P.C.): I would like to ask if the accumulative liability covering the employees who have been in the service of a corporation for a number of years couldn't be distributed in some way and carried as a liability?

MR. H. C. POWELL: (Toronto) I would like to suggest that some arrangement be made to publish in the Hydro BULLETIN a series of short articles or papers describing some of the pension schemes already in force. I think a number of the gentlemen here would like to study this question further if they knew where the information was available.

MR. D. PHALEN: (Walkerville). A short time ago a paper printed an article to the effect that the Hydro-Electric Power Commission of Ontario would pension their employees on the basis of the length of their service. If a person entered the employ of the Commission and worked two or three years they would receive a pension for the length of time they put in. I believe a number of the railroads have adopted this method.

MR. A. T. HICKS: (Oshawa). I would like to ask as to the position of the employee who has been with a private company for ten years and then that company is taken over by the Hydro. I think those people should be considered if the question is brought up. There are a good many in that position.

MR. C. E. SCHWENGER: (Toronto). We have recently heard a good deal in connection with group insurance. I do not know how far that proposition would deal with this system of sick benefits.

THE PRESIDENT: Perhaps Mr. Gibbs of the Westinghouse Company can throw some light on this subject.

MR. H. T. GIBBS: The Westinghouse Company has put in force a system of pensions and a benefit scheme whereby the men pay on a percentage basis, or rather the Company fixes one per cent. of the aver-

age monthly salary covering a period of ten years. The Westinghouse Company has tried the pension and benefit schemes together and only time will tell whether that is wise or not. Professor Mackenzie says it is not wise.

In connection with the pension scheme the company has set aside a definite amount of money which is supposed to take care of the pension scheme. We are doubtful whether it will. The scheme that we have worked out has been done on an actuary basis. A scheme of that kind necessarily must be worked out on that basis to succeed. I believe criticism was made of our company when this was started. The great number of employees in our company made it difficult to work out a low rate, but I think I can say that the employees are quite satisfied with the proposition to date.

MR. J. E. COOMBS: (Bradford). I would like to know how this would affect a man that we would engage as a local?

PROFESSOR MACKENZIE: I have to say to you as I say to my own classes, you have been asking lots of questions I cannot answer, for there are a lot of things I don't know.

In regard to the European and British Governments' reports on pensions, my recollection of that is that they were for the whole community; that is to say, like the English old age pension for any laborer who after a certain age receives so many shillings a week. To a certain extent this has been adopted on parts of the Continent. I do not know of any commission regarding pensions to a limited group on an actuary basis later than the Cronk Commission which was appointed in 1902 and, if I remember rightly, reported in 1907. It was on the basis of that that the British Pension Act of 1909 was made.

In reply to the gentleman who asked me about the liability in respect of past services, there is no reason on earth why this should not be calculated and carried as a liability. The trouble is to put the asset against it.

As to literature on this subject, I will put in at the end of the paper when it is printed the names of certain publications where you can obtain such information. I think you will get the most information applicable to conditions on this continent from that wonderful report of the Illinois State Pension Law Commission. That Commission sat for three years and they were splendid men, the very best type of men, and they made a magnificent report. It is in two volumes, the first one goes more into detail and the second one shows their recommendations. The first report came out in 1918 and the final one in 1919. I will put in at the bottom of the paper reference to certain publications where information can be found.

As regards group insurance, it is a subject I don't care to express an opinion on, as it is rather a debative subject just now. The point is this, if you adopt the pension scheme you will have to have a benefit scheme with it. Sooner or later you will be forced to add such a scheme. You could not carry on a pension scheme very long before your employees would force you into a recognition of a benefit scheme. I think history shows that pretty plainly, and when

you do that you are doing your own group insurance. It would not be wise to take group insurance out and carry your own pension list. The two should be worked in together because they are co-related.

Several of the questions referred to a possible pension scheme that may be adopted by the Hydro. Of course, that is a question that should not be put to me, it should be put to Sir Adam Beck. *(Laughter).* I can't answer questions of that kind, as to how it would affect a man who was employed by a company that was taken over by the Hydro-Electric. Those are matters that I should not answer.

Mr. H. F. Shearer: (Smith's Falls) I am sure Mr. Mackenzie has given us an exceptionally interesting paper, and whether we are able to put into practice this scheme or any modification of the principles, he has given us a great fund of information that we can stow away till the time comes when it may be useful to us.

I believe it will not be long until some such scheme will be adopted whereby not only the Hydro-Electric Power Commission of Ontario but the various municipalities will be found linked up in a scheme that will cover the Province of Ontario.

I have very much pleasure in moving a vote of thanks to Professor Mackenzie for his very able paper on this subject.

Mr. V. S. McIntyre: (Kitchener) Taking into consideration the many points that would arise in adopting such a scheme for the Hydro-Electric, I don't think the paper could have been better prepared. I have much pleasure in seconding Mr. Shearer's motion. *(Unanimously Carried.*

Report of Regulations and Standards Committee

Your Committee has endeavored to secure information in view of adopting Standard Plugs and Receptacles.

The sale of appliances and satisfaction in the use of same by the public has been hindered owing to the confusion in existing Plugs and Receptacles.

After careful consideration the Committee reports as follows:

Inasmuch as there is no standard practice covering the design of plugs and receptacles for permanent installations and also that there is great need of having plugs and receptacles whose parts are interchangeable, be it resolved that this Committee recommend and adopt the use of receptacles, plugs and plug caps as follows:

1. Receptacles shall have a parallel Contact or Contacts suitable for both parallel and tandem caps.

2. Plug bases shall have a parallel contact or contacts suitable for both parallel and tandem caps.

3. Caps shall have parallel contacts.

4. Dimensions of contact of caps shall be as follows:

Outside	.560
Inside	.436
Width	.250
Thickness	.062

This report your Committee most respectfully submit.

Signed, A. T. Hicks, R. H. Staford, T. C. James, H. F. Strickland, E. H. Porte, K. A. McIntyre, J. A. McKay—Committee.

Report of Special Committee *re* Rates

Mr. President and gentlemen, at the January Convention a discussion came up of the charges for electric ranges and our President appointed a committee consisting of Mr. Phelps of Sarnia, Mr. Jackson of Chatham and myself to consider this matter. We had our meeting down at Windsor and we had the assistance of Mr. McHenry while there.

The question has been asked why should a house with a floor area charge of thirty cents, with a connected load in lighting of say 600 watts pay the same service charge as the same sized house adjoining with an electric range of say ten times the connected load. On looking into this matter we found it was a pretty hard thing to justify that condition which exists at the present time.

The question has also been asked why should a man with a motor say of five horsepower capacity pay a service charge of a dollar per horsepower a month and another with a range of greater capacity get off with a service charge of from thirty to ninety cents a month. Your Committee is not willing to admit that there is a discrimination in these two cases to the extent that exists in the case of a house without a range and a house with a range. The reason for that is the great diversity in the matter of electric ranges as compared to motor load. In our own case at Windsor we have electric ranges with a connected load of more than three thousand kilowatts and the greatest load traceable to electric ranges that can be seen on our charges amounts to less than 300 kilowatts. This gives a ratio to the two connected loads of less than ten per cent., and in the case of motors on our system the ratio is nearly fifty per cent. For this reason your Committee is not willing that electric range users should be put in the same class as motor users and be asked to pay a service charge of a dollar per horsepower per month the same as the other user.

There is another thing to be considered; large municipalities have a large number of ranges and they believe that even the range load carried at the present time with existing rates is a profitable one. The question is, are you prepared to go ahead and take on range users up to twenty-five per cent. of your number of domestic customers, fifty per cent., or one hundred per cent? While it may be profitable up to ten per cent. is it going to be profitable as the number of range users continually increase? It is not going to be possible for the Utility after it has reached ten per cent. of the number of its domestic users of ranges to refuse new accounts because the business ceases to be a profitable one. That would be a discrimination of a character that no Hydro Commission could be a party to, and so your Committee thinks that the basis of charges for electric ranges should be made so now that it would be self-sustaining for all time to come, or as near as can be possibly determined.

With all these things in mind, your Committee desires to make the following recommendations:

That all domestic heating or cooking appliances with an individual cap-

acity of greater than 660 watts be asked to pay on the basis of a minimum service charge of ninety cents. This would mean that the number of kilowatt hours paid for on the Hydro load will be ninety.

Signed, O. M. PERRY, J. E. B. PHELPS, J. G. JACKSON—Committee.

Aubrey Falls, Mississagi River, Algoma, Ontario.

Merchandise Accounting for Hydro Municipalities

By G. J. Mickler, B.A. Sc.

Assistant Auditor of Municipal Accounts, Hydro-Electric Power Commission of Ontario

PERHAPS no department within the control of Municipal Hydro Utilities is so poorly administered and so inadequately furnished with the machinery necessary for its proper handling as is the "Merchandise and Jobbing" department.

While the prime purpose of all municipal electric utilities is only that of distributing electrical energy, nevertheless the growing popularity of that element of usefulness, with the corresponding demand for appliances and devices for its utilization, often makes it imperative that central distributing stations engage in the business of merchandising electrical appliances and very often of taking up wiring of consumers premises as well. This practice is found necessary to insure the proper installation of equipment most suited to the brand of energy being distributed, also to afford a measure of protection to the consumer who is so often swindled into purchasing and installing appliances not at all suited to his needs, and inefficient as well.

The purpose of this paper is to outline a system of stock records, billing and office records to safeguard the purchases that are made by Hydro Municipalities of merchandise for sale, and to ensure the ultimate collection from customers of the amount of their purchases.

Fundamental Principles

The fundamental principles governing the establishment of a suitable accounting system may be summed up in the following way:

(1) The system should be simple.

(2) All forms should be standard and their number kept to a minimum.

(3) All sales, whether contract, instalment, credit or cash, should be posted and a complete, detailed record kept of them.

(4) A merchandise account should be created showing debits for purchases and credits for material sold or disposed of in any way.

(5) A stores record of material purchased and stocked, should be kept, where possible, to keep accurate accounts of all material and to facilitate the checking of periodical inventory.

(6) A general ledger containing all accounts should be made part of the system.

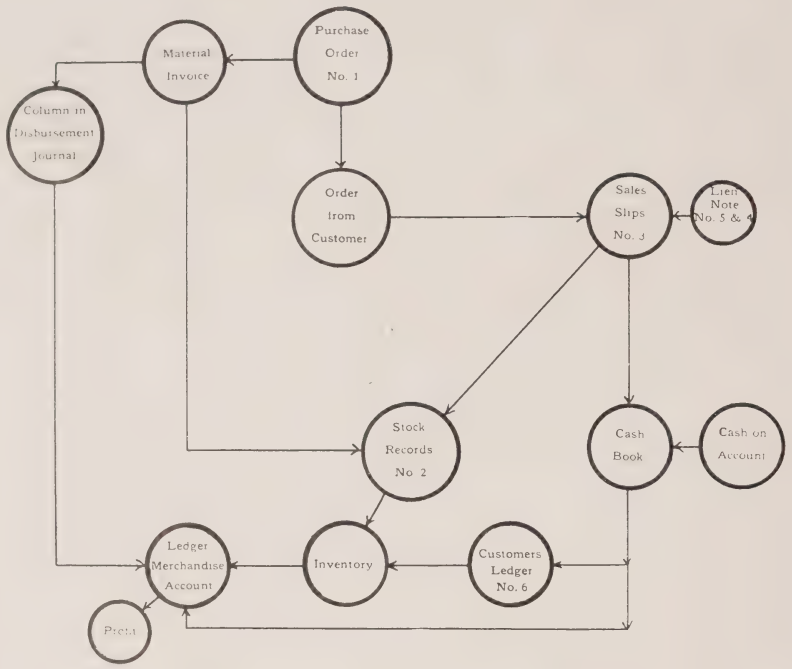
Classification

Hydro Municipalities may, for the purpose of merchandise records, be divided into two general classes:

(1) Those under which the cash record, in-bound, out-bound, forms the basis of all original entries and no control accounts are possible.

Business in these places is usually carried on in a small way, so the complexity of control accounts may be avoided.

CHART NO. 1



(2) Those in which expert accountants are employed and where all the requirements of good accounting can be put into practice.

No. 1 may be further sub-divided into two classes:

(a) Municipalities engaging in merchandising business only.

(b) Municipalities engaging in the wiring and jobbing as well as the merchandising business.

CLASS 1 (a)

Under this class it is assumed that no wiring business is transacted and that appliances and small supplies are handled. The records obtained are on a cash basis and the keeping of control accounts is not feasible.

On the accompanying Chart No. 1 are graphically illustrated the various steps to be taken from the time the material is ordered until the profit

and loss account is reached. The forms recommended for use are referred to by numbers in the different circles, and the lines connecting the circles indicate the sequence of the accounting operations, or the way in which the business flows through the accounts in the system.

Purchase Requisition

The first step for this class of business is to put in a stock of material to do business with, and each purchase of material is to be covered by a requisition or purchasing order. In the ordinary municipality a Purchase Requisition of very simple form only is required and that illustrated as Figure 1 is designed for this purpose. The form is so simple as to require no explanation, except that it is to be made in duplicate, one copy for the manufacturer and one for office use.

Incoming Invoices

The invoice from the manufacturer occupies the second place in the system. On the receipt of this invoice, it is to be checked against the purchase order and verified, after which the material received should be examined and checked as to quantity, size and so on, to correspond to the invoice. Shortages, breakages or articles requiring refund or credit from the manufacturer, should be

PURCHASE ORDER

No.---------- Date ----------19-----

To----------

Please Ship To----------

Ship Via----------

Required---------- Mark Goods----------

Quantity	Cat. No.	Material	Price

Signed----------

Manager

Fig. 1

STOCK CARD

No.---- ---- Max.----------

Article---------- Min.----------

Received					Withdrawn			Balance in Stock	Value	On Order
Date	Order No.	Quantity	@	Value	Date	Order No.	Quantity			
	Forward					Forward				

Fig. 2

dealt with immediately information regarding them is available, and on the receipt of a credit note, such is to be attached to the original invoice and both passed on for payment.

Card Record of Stores

When the material is taken into stock, it is to be kept in a safe place, preferably under lock and key, and no one but the person in charge of the material should have access thereto. It is also necessary to keep account of all material in-bound and out-bound, and for this purpose the card records of stores are introduced.

A card is to be made for each item of material purchased, and the entries are made on the receiving side immediately the goods are received and the invoice checked. The invoice is to be marked to signify that the stock record has been properly entered therefrom. A rubber stamp with this and other necessary particulars on it, with blanks to fill in for various operations, is recommended for this purpose.

Figure 2 illustrates a form of Stock Card of special value for the purpose which it is supposed to accomplish. Space is provided for all incoming items with their cost and total value, also for withdrawal items as well as for the balance of material on hand, with the total value of this balance. This last feature enables one to determine at once the average value per unit of the material recorded, also to check up with the inventory as to quantities, and to price the quantities on hand in the inventory.

Collection of Charges to Merchandise Account

When the invoices have been checked and approved for payment they are vouchered and paid in the ordinary way, and as the disbursement journal is provided with a special column to take care of merchandise charges, this supplies a medium for

collecting all the charges to the Merchandise Account, and the total thereof is posted periodically in the general ledger.

Expenses Other Than For Materials

Into this column are carried also all charges incidental to the carrying on of the merchandise business, such as freight and express, rent, office expenses and salaries, advertising and other miscellaneous expenses; and the total debits in the Merchandise Account represent all the costs of the Merchandise department.

Sales Slips

Now that material is in stock and paid for, business with the public can be carried on and sales affected. Material may be sold and disposed of in a number of ways—by cash sales, credit sales, on the instalment plan or on approval, and the Counter Sales Slip, as illustrated by Figure 3, is provided to take care of all of these classes of sales. The slips are bound in triplicate, one copy to be given to the customer at the time of sale, the duplicate to be retained for cash book or customers' ledger records, and the

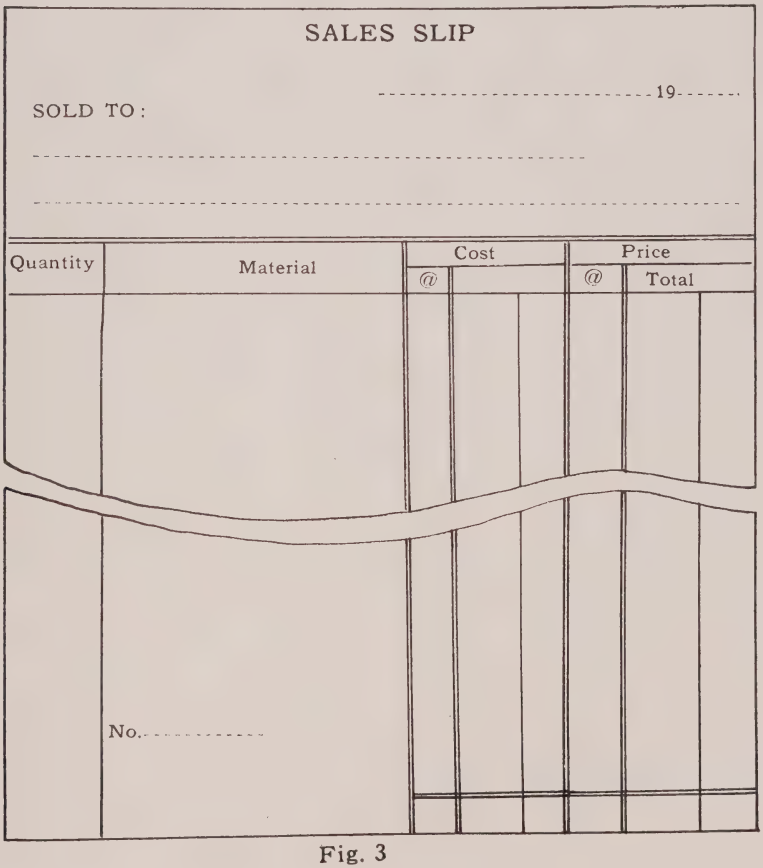
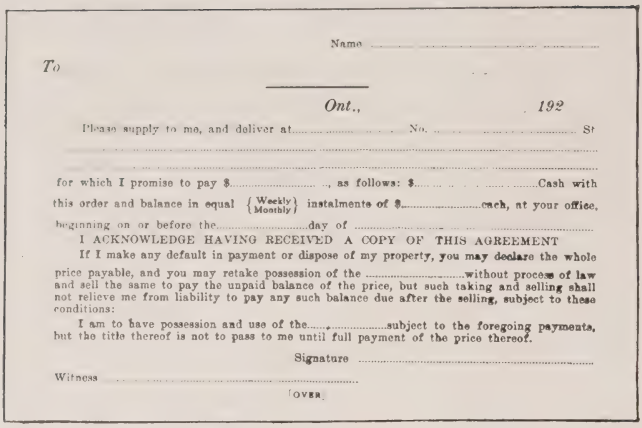


Fig. 3



Name .....

To

.....

Ont., *192*

Please supply to me, and deliver at..... No. ..... St

.....

.....

for which I promise to pay $..... ., as follows: $.....Cash with

this order and balance in equal {Weekly / Monthly} instalments of $.....each, at your office,

beginning on or before the.....day of .....

I ACKNOWLEDGE HAVING RECEIVED A COPY OF THIS AGREEMENT

If I make any default in payment or dispose of my property, you may declare the whole price payable, and you may retake possession of the .....without process of law and sell the same to pay the unpaid balance of the price, but such taking and selling shall not relieve me from liability to pay any such balance due after the selling, subject to these conditions:

I am to have possession and use of the.....subject to the foregoing payments, but the title thereof is not to pass to me until full payment of the price thereof.

Signature .....

Witness .....

OVER

Fig. 4

triplicate to remain in the binder to form a complete record of all sales, also to provide a check in case of error, and for stock record entries. All copies of these slips are to be numbered consecutively, the purpose of which is obvious. In order to keep proper account of all sales, an unbroken record of them must be available and the consecutive numbers, if printed on the forms by the manufacturer, provide such a record. Every slip, both duplicate and triplicate, must be on file and available for check by the auditors or others whose business it may be to check them.

Credit Sales

When a customer makes a purchase, the clerk makes out a Sales Slip showing the quantity, description and price of the articles purchased, and the total amount shown represents the amount of the sale. Should the customer desire to take advantage of the credit terms allowed on some purchases, the terms of the sale are to be indicated on the slips, with the amount of deposit, if any, also shown; and, if the purchase is made on the instalment plan, full particulars as to price and amounts of the instalments as well as the original payment are to be shown. The original slip is then given the customer and the copies retained as indicated above.

Lien Notes

With credit and instalment sales of any magnitude, preferably for amounts above a certain fixed minimum, it is recommended that the customer sign a Lien Note to guarantee the ultimate payment of the amount due or the return of the goods to the store. This practice is followed by all large credit merchandise houses with good results.

Figure 4 illustrates a form of Lien Note that covers almost every case of credit sale to be met with in the appliance business, and is very satisfactory because of its condensed form. The forms are to be made out in duplicate, one for office use and one for the customer, and they are to

be numbered with the number of the Sales Slip covering the sale.

Lien Notes are ordinary promissory notes with a clause added which prevents the ownership of the articles sold from passing to the purchaser until the notes have been paid in full.

Law re Lien Notes

In Ontario the Lien Law provides that for these conditional sales to be binding against subsequent purchasers or mortgagees without notice in good faith for value consideration:—

(1) The agreement must be in writing and signed by the "Bailee" or his agent.

(2) A copy of the agreement shall be left with the "Vendee" at the time of the sale or within 20 days after the execution of the agreement.

(3) A copy of the agreement shall be filed within 10 days of its execution, in the office of the County or District Court, in all cases except the following:

(a) A contract respecting manufactured goods, including pianos, organs and other musical instruments, which at the time possession is delivered have the name and address of the seller painted, printed, stamped or engraved thereon, *need not be filed.*

(b) A contract respecting household furniture other than pianos, organs or other musical instruments, *need not be filed.*

Articles thus sold and the note not being paid on maturity, the seller may retake at once, or he may sue on the note, and if he fails to recover he may retake the article.

Record of Instalments

Figure 5 shows the reverse side of this Lien Note form, which provides for the recording of different due dates and amounts of all instalments, also the dates and amounts paid and the balance still due.

Writing up Stores Records of Sales

At the end of each day if the volume of business warrants it, or at the end of some other definite period, the Sales Slips are to be compared with the Stores' Cards, and the withdrawals written up showing all the necessary particulars. It is to be noted on the Sales Slips that these records have been properly written up.

Entering in Cash Book

The duplicate of the Sales Slip, which is to be used as a record of cash received, is filed with the other cash collection stubs for light and power accounts, and the amounts entered up in the cash book in the regu-


INSTALMENTS DUE No.

Name ..... Total $ .....

Dates Due		Amount of Instalments		Dates Paid		Balance Due		Initials

Fig. 5

lar way. In the case of customers paying cash, the numbers of the individual slips are to be shown in consecutive order and the amount carried to the merchandise column provided for the purpose. The slips containing payments on account of credit sales or instalments are to be entered to show the name of the customer as well as the number of the slip.

Recording Payments on Account

For the recording of subsequent payments on account of credit sales or instalments, a Sales Slip is to be made out in the regular way, omitting of course any materials, simply showing the customer's name and address, and stating that the amount shown is a payment on account of instalment account number .....

Posting Cash to Merchandise Account

The total of the receipts at the end of every month, or posting period, is carried to the credit of the general ledger account "Merchandise."

Customers' Ledger

The Sales Slips representing credit sales are taken and used to open up a customers' merchandise ledger to keep track of all unpaid merchandise accounts.

Opening of Customer's Ledger

Figure 6 illustrates the style of Card Ledger used for this class of account. One of these cards is to be written up for each account to be carried and all particulars as to date of purchase and amounts charged to be shown in their proper spaces, as well as terms of sale and amounts of instalment agreed upon at the time of sale.

Indexing of Customer's Ledger

These cards are to be arranged and indexed in the order of the lighting

CUSTOMERS' LEDGER

No. .....

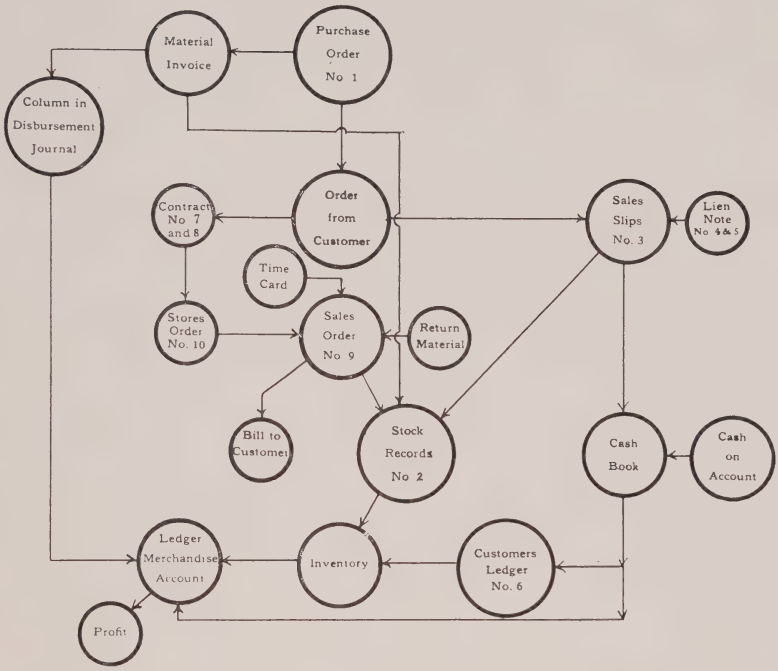
Name .....

Address .....

Date	Particulars	Terms	Folio	Dr.	Cr.	Balance

Fig. 6

CHART NO. 2



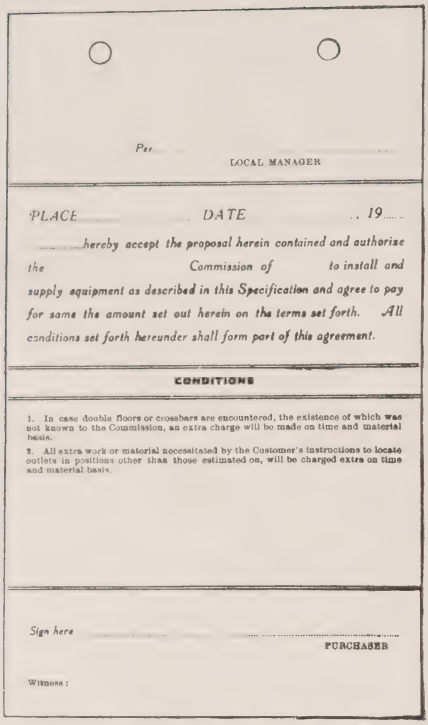
and power account cards of the Utility. This arrangement will prove valuable when it is found necessary to place on the customers' monthly bills the amount due on account of merchandise purchased, or on the instalments due, and affords also an easy way to locate the accounts.

Posting Customers' Ledger

When payments are made on account of any open accounts in this ledger, the posting is to be done from the cash book direct and the cash book entry should show the folio or signal to signify that the posting has been done. In like manner, the card should show the cash book page from which the amount was posted.

Filing Closed Accounts

Ledger cards for paid accounts, or



Per .....
LOCAL MANAGER

PLACE ..... DATE ..... 19.....

.....hereby accept the proposal herein contained and authorise the Commission of to install and supply equipment as described in this Specification and agree to pay for same the amount set out herein on the terms set forth. All conditions set forth hereunder shall form part of this agreement.

CONDITIONS

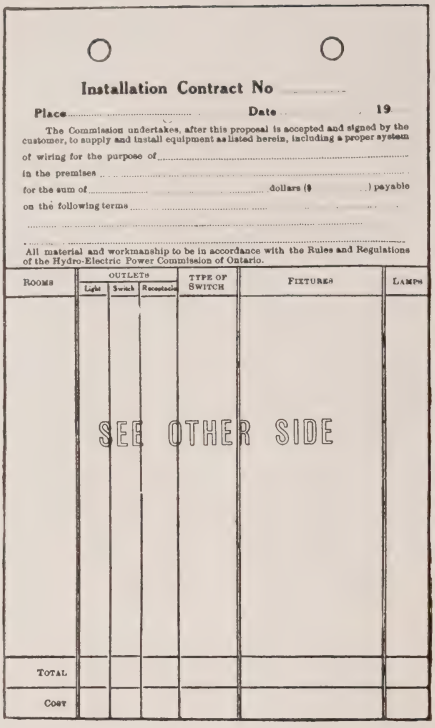
1. In case double floors or crossbars are encountered, the existence of which was not known to the Commission, an extra charge will be made on time and material basis.

2. All extra work or material necessitated by the Customer's instructions to locate outlets in positions other than those estimated on, will be charged extra on time and material basis.

Sign here .....
PURCHASER

Witness:

Fig. 7



Installation Contract No .....

Place ..... Date 19

The Commission undertakes, after this proposal is accepted and signed by the customer, to supply and install equipment as listed herein, including a proper system of wiring for the purpose of .....
in the premises .....
for the sum of ..... dollars ($ .....) payable on the following terms .....
.....
.....

All material and workmanship to be in accordance with the Rules and Regulations of the Hydro-Electric Power Commission of Ontario.

Rooms	Outlets: Light	Outlets: Switch	Outlets: Receptacle	Type of Switch	Fixtures	Lamps
SEE OTHER SIDE						
Total						
Cost						

Fig. 8

accounts which have been balanced, are to be filed in a duplicate index and are to be returned to the original index when more credit is extended.

Balancing Ledger and Inventory Into Merchandise Account

At the end of a business period a balance of customers' accounts, unpaid, is to be drawn off, an inventory taken and costed, and the total of these two items carried to the credit side of the Merchandise Account in the general ledger. In this account all invoices for material taken into stock and not yet paid for, are to be added to the debit side, and the difference between the two, debits and credits, represents the amount of profit or loss resulting from operations during the period.

These methods, with the forms outlined above, cover the simplest form in which merchandise records can be properly taken care of, and presupposes the handling of appliances and small supplies only.

Class 1—(b):

From the accompanying Chart No. 2 it will be seen that for the Utilities engaging in the wiring business as well as that of merchandising there are further records to keep. A customer desiring some work done, say a wiring installation, has to sign a contract after the estimate of the cost of the job has been completed and the price named.

Contracts

A form of specification and contract is illustrated in Figures 7 and

8, which answers the purpose very well; one side showing the installation particulars gives the customer an idea of what he is getting for his money, also an opportunity to check the actual installation against the specifications. The reverse side shows the contract itself with its reservations. Contracts should be numbered to agree with the number of the sales orders next referred to.

Sales Orders and Stores Requisitions

The contract signed, a Sales Order, such as Figure 9 is made out, and at the same time a Stores Requisition, such as Figure 10, on which is listed the material required for the job, is

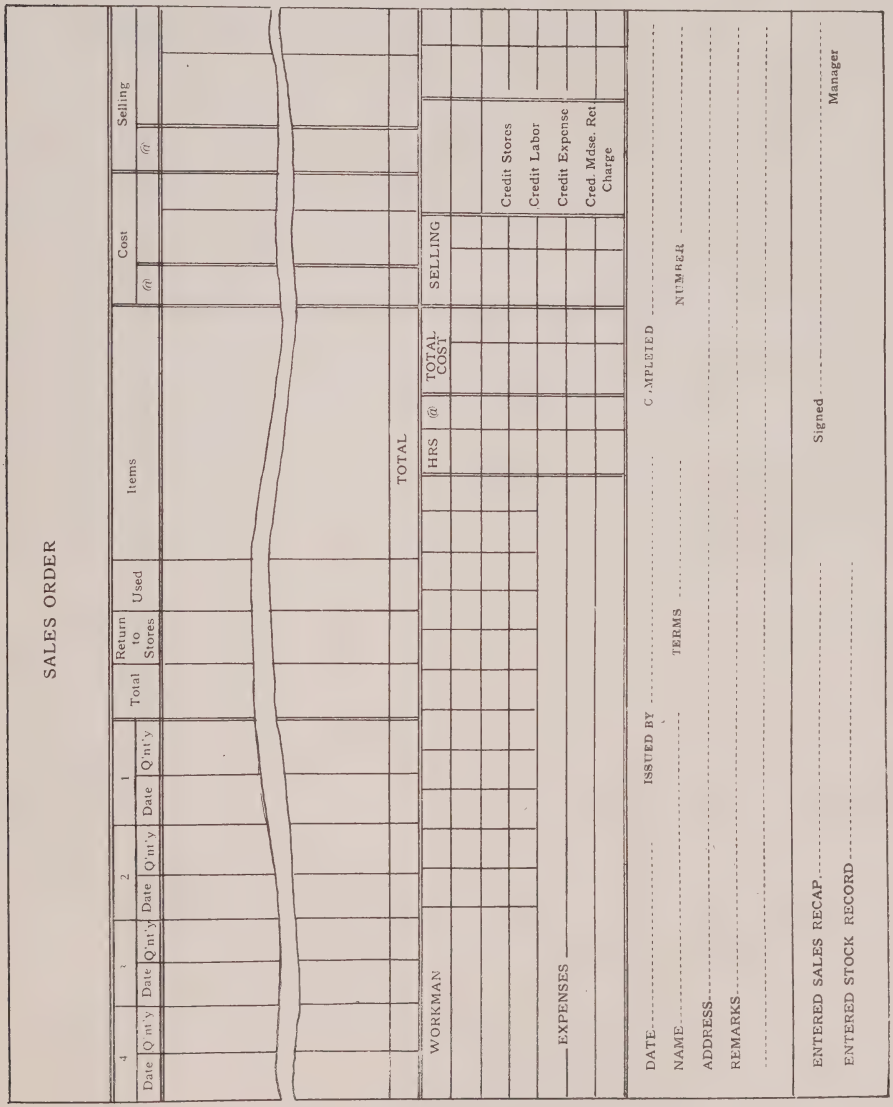
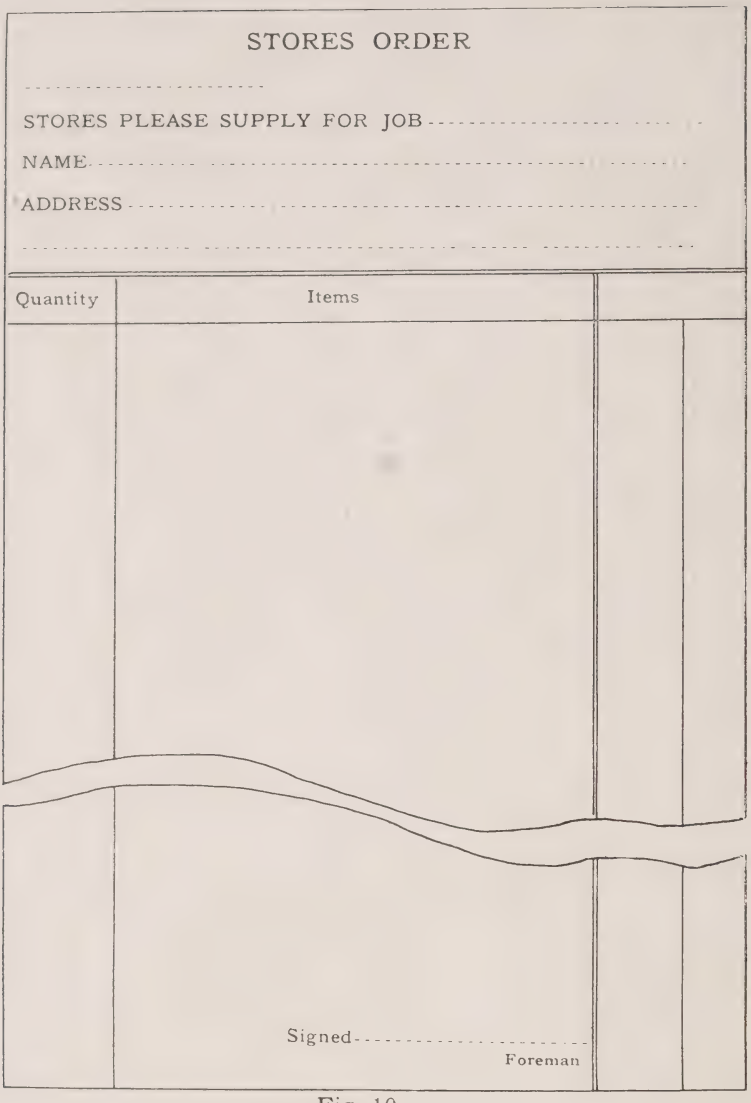


Fig. 9


STORES ORDER

STORES PLEASE SUPPLY FOR JOB

NAME

ADDRESS

Quantity	Items	

Signed

Foreman

Fig. 10

to be filled in. These Stores Requisitions are to be made in duplicate, one for the work foreman and one for use in entering the particulars on the sales order and on the stock cards.

Filling in Sales Orders

The Sales Order, it will be noted, provides for the taking out of 4 lots of the same item of material, i.e., if a number of items have been listed, and more than any one of them is required for the job, a second entry to the left of the first is made for the second quantity taken, and so on, thus avoiding changing the original amounts set down and allowing a check to be made with the stores requisitions.

The Sales Order also provides space for the time of workmen employed on the job and the entries for the time are to be made from the time cards, one of which it is supposed every utility employing men requires to be made out daily. Space is also provided for sundry expenses incurred.

Completing Sales Orders

When the job is completed, the net amount of material used is figured out. The cost per unit is taken from the stock cards, and the total cost of the material thus used determined. The selling price is also extended on the form for each item for record purposes, unless the customer be billed on a time and material basis, in which case the selling prices will be used as the basis of billing. The labor cost and sundry expense items are to be figured out and extended, as well as the selling prices of these items, and the form is then complete as called for, and ready to have the customer's bill made out.

Numbering Sales Orders

These Sales Orders are to be numbered consecutively when issued and filed in their proper order in a Shannon file and preserved for use when making future estimates; also to provide a means of checking by auditors against the record of customers' accounts rendered.

Writing Up Stock Cards

The entries on the Stock Cards for material used are to be made from the Material Requisitions when issued, and returns to the stores of materials unused are to be recorded on a Material Requisition also, and the fact that the material has been returned from a particular job indicated, after which the quantities are to be entered on the Stock Cards as material received.

The method of handling purchases, invoices, and incoming material records for this combination of merchandising and jobbing, is just the same as that outlined in Class 1 a., as is also the procedure referring to cash and other classes of sales, right through to the Profit and Loss account, the only difference between the two classes is that the wiring and jobbing business has been fused into the records of Class 1a, so the operations of that class need not be gone over again.

Class 2.

Chart No. 3 is somewhat differently arranged from Nos. 1 and 2, although in the main the procedure to be followed in all three is the same.

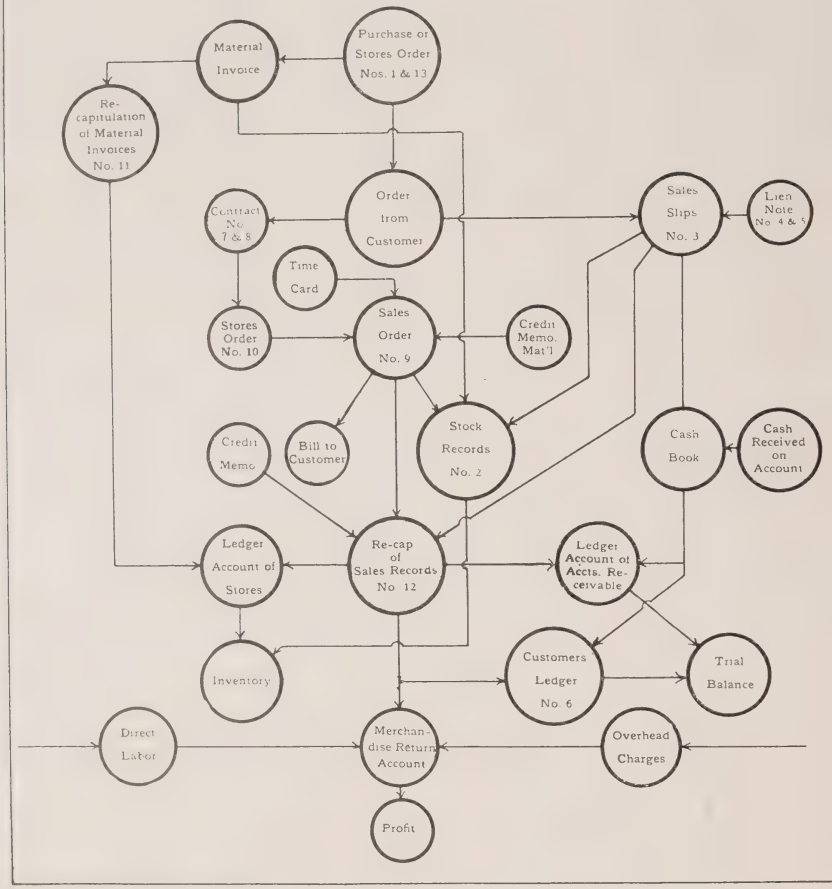
For utilities in Class 2 which operate a Merchandise business in connection with that of Wiring and Jobbing, forms must be provided for the carrying of all the records to the control accounts that it is necessary to keep, to complete the accounting system. Otherwise the routine as outlined under Class 1 a and 1 b will be followed.

It is assumed that the Merchandise Department of these utilities purchases material from the manufacturer, or is able to procure some materials from a General Utilities Stores Department.

Extra Requisitions for Purchases or Stores Transfers

The Purchase Requisition described as Figure 1 will be supplemented by extra copies as per Figure 13, enough copies of which are to be made to suit the needs of a particular utility.

CHART NO. 3



For purchases made outside, there will be required one copy for the manufacturer, one for the use of the Accounting Dept. and one for the Merchandise Dept., and all copies will be similar to Figure 1. In case material is procured from the General Stores, 4 copies will be needed, 3 copies as per Figure 13 will be sent to the Stores Dept. and 1 as per Figure 1 retained on file in the Merchandise Dept.

Of the first three, two are to be returned to the Merchandise Dept. with the shipment or transfer of material. The quantities and prices at which Stores holds the material for transfer are to be noted on these two copies, when they will form inter-department invoices in duplicate. When these

have been checked and verified, one will pass on to the Accounting Dept. for further recording, and one retained by the Merchandise Dept. The third copy will be retained by the Stores Dept. for its files.

Listing Incoming Invoices

Invoices for material, whether from stores or from outside firms are to be listed as received according to date, after they have been properly checked. The listing can be done in an ordinary Journal, illustrated as Figure 11 and the total of these purchases journalized therefrom to the General Ledger Account of "Merchandise Stores."

Costing Sales

The cost of material sold by counter sale slips is to be determined from the Stock Cards and shown on the office copies of the slips which are filed in numerical order.

Listing Sales

The jobbing sales orders and counter slips are to be listed on form Figure 12 in their respective consecutive order. It will be observed that the form calls for a distribution of selling prices into three columns, Cash Sales, Credit Sales and Instalment Sales. This is to permit carrying separate control accounts for each of these classes of accounts. The Cash Sales total must also agree with the record of total Cash Sales recorded in the Cash Book for like periods of time.

Distributing Cost and Selling Price

The cost is to be distributed into the columns entitled Materials, Labor and Expenses, and the Merchandise Return Account represents the difference between the Cost and the Selling Price. All of these items can be de-

INVOICE JOURNAL

Date	Order No.			Amount Dr.	Amount Cr.

Fig. 11

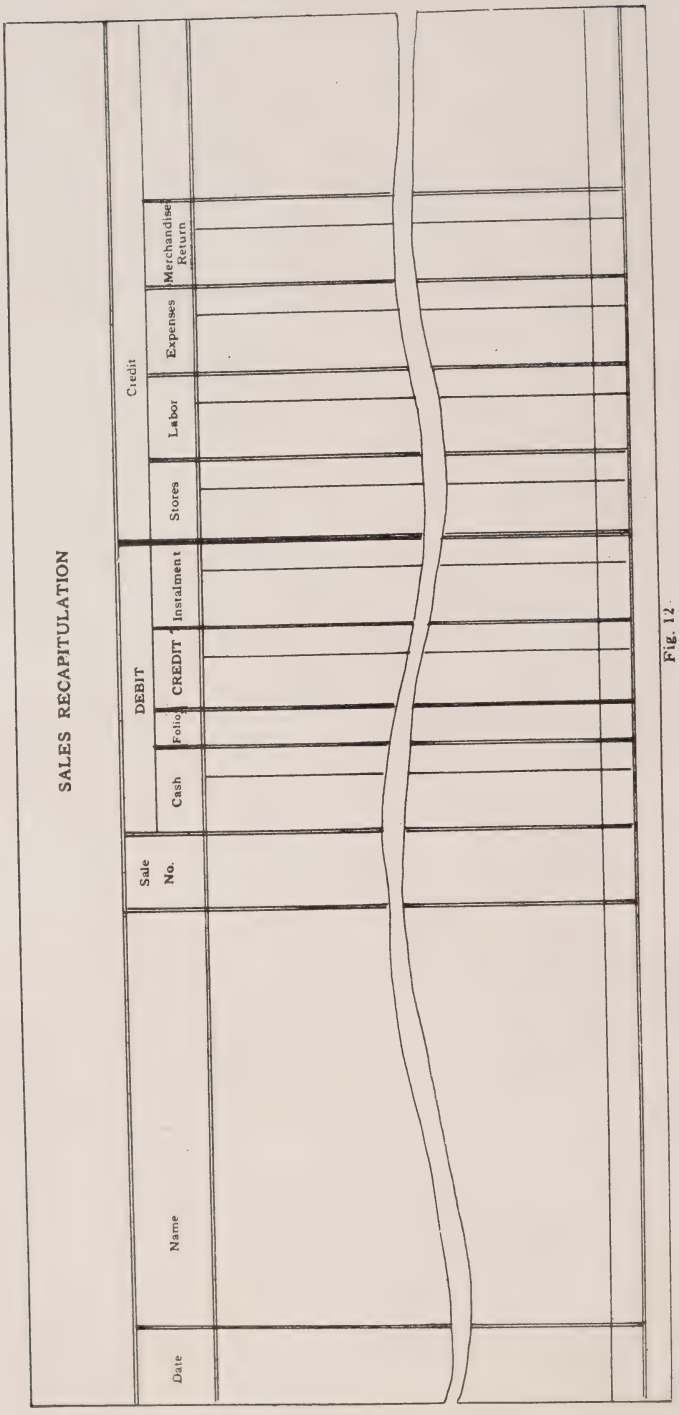

SALES RECAPITULATION
Date
Name
Sale No.
DEBIT
Cash
Folio
CREDIT
Instalment
Credit
Stores
Labor
Expenses
Merchandise Return

Fig. 12.

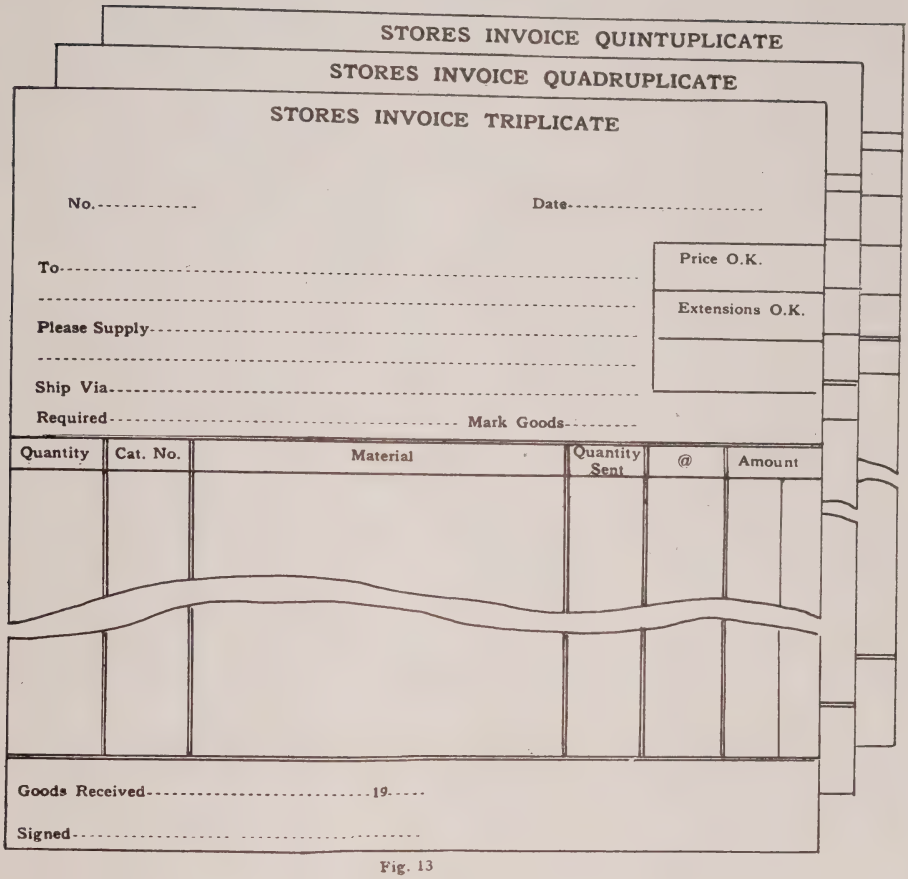


Fig. 13

termined from the Sales Orders and the Cash Sales Slips, if these have been properly executed. Credit memoranda for materials returned by customers or for credits and other allowances made will be made out either as Sales Slips or Sales Orders, properly indicating that they are to be treated as credits, and numbered in the regular sequence of the other debit orders, and put through the recapitulations in red ink. The totals of the debit columns will be posted to the General Ledger "Accounts Receivable" Account, and the totals of the credit columns to the various accounts indicated.

Posting Sales.

Posting to the customers' ledger accounts is to be done from this Sales Recapitulation, on which folios referring to ledger accounts are noted. Folios are also to be shown on customers' ledger cards to refer to the recapitulation pages, from which the posting is done.

Posting Cash.

The cash received for Cash Sales or on account of Customers' Ledger accounts is posted to the credit of the General Ledger, "Accounts Receivable" Account direct from the cash book. At the end of a business period, say monthly, this control account bal-

ance is to be checked against the total of the balances in the Customer's Ledger, and the two balances should agree.

Making Inventory.

At the end of a year or any other period, as may be desired, the inventory of material is to be checked against the quantities reported on hand at the average price per unit of cost as shown on the stock cards, and the total value of the inventory is to be checked against the balance in the control account, "Merchandise Stores." These should agree.

Merchandise Return Account

With the inventory and the accounts outstanding verified against the two control accounts, it is next necessary to turn attention to the "Merchandise Return" account. This account, as can be seen from this chart, and as indicated on the record of Sales Recapitulation, is the gross difference between the bare cost of materials sold, and the total return for materials, labor, and all other items, as well as profit, as indicated by the Selling Price.

Overhead Charges

In order to determine the net profit for any period, items directly or indirectly affecting the cost of merchandising, must be carried to this "Merchandise Return" Account. Direct labor charges as affecting the Sales Orders will be charged through the Pay-Roll Distribution monthly. Salaries and Wages of Stores' Clerks, Salesmen and others will be charged from the Pay-Roll distribution. Other items such as advertising, rent, heat, light, repairs, insurance, taxes, interest, telephone, printing, delivery, travelling and other miscellaneous expenses will be charged to this account through the medium of the record of Accounts Payable or Disbursements, if direct charges can be made, or as proportions of regular accounts of the utility, if general accounts for such items are kept, or both, as the case may be.

Profit

The net amount remaining in "Merchandise Return" Account, after all the charges as enumerated above have been made, represents a profit if it is a credit, and a loss if it is a debit balance.

The various systems outlined above, may to the ordinary layman, seem very complicated, and the accompanying charts confusing at first sight to even some with considerable accounting experience and knowledge, but close study will reveal how simple everything really is, and that nothing can be eliminated if a complete record of every transaction and a complete record of stock is to be maintained. It should be the aim of all Hydro Municipalities to be able to keep their records in the most up-to-date fashion, and while these systems may not meet the requirements of any and every one of them, they are sufficiently flexible to permit any Municipality to adopt one or the other with but slight variations, depending on the general system of accounting in use for the utility accounts.

Let it be known also that for Municipalities desiring to adopt the systems of Class 1 a and 1 b, arrangements are being made to have the necessary forms carried in stock by the Hydro-Electric Power Commission of

Ontario, thus enabling these utilities to purchase such forms at a minimum of cost and uniform as well.

Assistance will also be given to any Municipality when ready to instal a system of Merchandise Records, to make sure that everything is properly installed.

Discussion on Mr. Mickler's Paper.

THE PRESIDENT: Mr. Mickler seems to have covered very thoroughly all the accounting procedure necessary in connection with selling appliances and the work of electrical installations for customers, but I am sure there are a great many members of the different utilities that have questions they would like to ask in regard to difficulties they have encountered in carrying out merchandise records.

MR. H. P. L. HILLMAN: (Toronto) Mr. Mickler has covered this subject so thoroughly that it is rather difficult to find any point upon which to offer any suggestions.

One very important feature in connection with appliance sales is the necessity of balancing the cash sales daily with the teller's records; that is accomplished through the sales journal.

Another very important feature that Mr. Mickler points out is the necessity for keeping appliance stock under lock and key, and records should be carefully kept of appliances that are in the storeroom, or in the sales room. Unless careful record is kept of merchandise that is on the floor, sales may be made without being recorded or appliances may disappear.

One feature in connection with lien notes which Mr. Mickler points out is that they need not be registered if the apparatus bears the name and address of the seller. Distinction must be made between the manufacturer's name being on the appliance and the actual name of the seller. If you are selling a washer, for instance, which does not have the name of the particular Utility that is selling it, it is necessary that that lien note should be registered. It is also required that the appliance is identified, particularly with regard to the serial number. Cases have come up in the sales of small motors and washing machines where serial numbers were not properly reported and there was difficulty in proving the ownership of the appliances.

Another very important feature pointed out by Mr. Mickler is that sales slips should be numbered by the printer and preferably these sales slips should be recorded in the sales journal in numerical order. This method fascinates auditing. Sometimes it happens that appliances sold in one month are not delivered until the succeeding month. Where the Utility closes its books monthly it is desirable that the sales slip numbers which have not gone through the records should be carried forward into the sales journal in the succeeding month, even if there is no sale opposite it.

Another rather important feature is the question of customers returning appliances which for some reason or

other they do not wish to keep. Mr. Mickler suggests using sales slips for that purpose, but in the case of large Utilities it is probably desirable that special forms of return vouchers should be used, which would record on them the original sales slip numbers and the name of the purchaser and address, and the disposition of the appliance when it comes back, whether it goes to the stock room or on the floor of the sales room. These return vouchers should be properly authorized before the teller is advised to refund the money.

A very important class of material which should be carefully accounted for is lamps. In our office it is the practice to balance the lamp sales daily against our lamp stock. That provides for insuring carefulness on the part of the employees in regard to class of lamps sold, and it warrants also a valuable source of information for the Utilities, so they may know what lamps are most in demand, and in that way they are able to keep track of their stock and replenish it as time goes on.

A very effective method of collecting installment sales it to combine them with the regular lighting bills. In this way the customer understands that the installments are to be paid with the regular bills.

I don't know that there is anything more I would like to call attention to. Mr. Mickler's paper is particularly thorough.

Mr. G. W. Blay: (London). Mr. Mickler's proposed system is hardly open to much criticism, as far as London is concerned, for the good reason that, in all essentials, it follows definitely our own system of accounting. I have followed Chart No. 3 step by step, in the light of our own accounting practice, and this chart is, to all intents and purposes a graphic illustration of our own system.

I can say little about the specimen forms submitted by Mr. Mickler. It is my opinion that forms of this nature can hardly be standardized. Local conditions and local requirements are by no means fixed quantities, and these forms must be modified and varied as conditions gradually change, to keep them practicable. I need hardly say, however, that the principles on which our forms are based do not vary from those furnished in the paper.

Mr. Mickler has assumed that the retail sales department and the jobbing department for wiring are one and the same department—at least it would appear that he expects the same accounting machinery to look after both departments. In London we have two separate departments—one, the Hydro Shop, to sell appliances, and the Wiring Department. But this is only a variation in practice, not principle, from Mr. Mickler's plan.

In our municipality, the system installed binds the Hydro Shop closely to the mother department, in the same manner as any branch office of a private firm is bound to its head office. The Hydro Shop also uses the mother department as its banker, that is to say, the mother department is responsible for all the indebtedness incurred by it. It has no liabilities at all, except to the main department. It carries no cash (except, of course, enough current funds to make change, etc.) and all moneys received are deposited

daily with the secretary of the main department. The system we now have operating permits the collection department to take the public's money for Hydro Shop transactions with the same routine facility as it collects water or lighting rates: through the same wickets: through the same cashiers. This applies of course to wiring transactions also. To be adequate, a system has to allow such transactions as the purchase of a coffee percolator, payment on the wiring of a house, the water rate, and the monthly lighting bill, to be settled by one cheque if need be. In actual practice this happens scores of times daily, as our mails will testify.

A color scheme of invoices (with the usual stubs) looks after this quite readily, with a "Hydro Shop" column which runs through the accounting system of the main department, keeps the clerical work down to an absolute minimum, as it permits of totals only being posted to the head office controlling account, while the pieces, in detail, readily fall into place in the Hydro Shop's subsidiary system. This latter system, although subsidiary, is a full and complete accounting system in itself (along the lines set out by Mr. Mickler) and enables us to compete with progressive private firms without any bookkeeping handicaps. One advantage, from the viewpoint of the retailing department, in keeping their accounts separate from the wiring department, is that it enables them to keep a much closer tab on stocks than would appear to be possible with Mr. Mickler's plan. The stock of a retail store selling electrical appliances, seems to fall naturally into a classification somewhat along the following order. At least, they did in London:

(1) Irons.

(2) Washers, and ironers for laundries.

(3) Cleaners, such as vacuum machines.

(4) Fans.

(5) Heaters, (air).

(6) Stoves and ranges—cooking contrivances.

(7) Miscellaneous Appliances of all sorts, such as, for instance, hair cutting machines, toy trains and novelties.

(8) Sewing machines.

(9) Toasters and Grills.

(10) Fancy lamps and illuminating devices with fancy shades, etc.

(11) Materials for repair work of all kinds.

(12) Lamps—ordinary glass bulb.

(13) Motors—actually in stock.

(14) Motors—on rental or on loan.

Subdividing our merchandise thus allows us to keep a close grip on the stocks carried, and this is all important these days, with prices fluctuating as they are.

Having such a subdivision of our merchandise, it follows naturally that the form we use corresponding to Mr. Mickler's Recapitulation of Sales Records (No. 12) is altogether different from the specimen shown. Our form is columnized to enable us to enter cost prices under the heading of the stock concerned, and the totals of these columns form the basis of a journal entry, at the end of the month. In actual practice, we have two of these Recapitulations of Sales Records, one looking after Cash Sales, and the other after the Time Sales. I note that Mr. Mickler's system keeps tab

on installment sales (as apart from Credit Sales). This is a point worth looking into and I intend to take it up with our accountant some time.

Our Wiring Department accounting stays very closely to the chart furnished in the paper. I note one difference however, a very minor one. In London, the labor put in on a job does not find its way on to the storekeeper's requisition (or sales order) but on to a progress report of the wiring foreman, who sends these into the office, where they are held. The last of such progress reports and requisitions is plainly marked "Render Account," when the customer is billed. I may mention that a job might be entered into where the material supplied was a small matter, whilst the labor was everything. And the foreman's progress reports look after this quite satisfactorily.

Mr. Mickler: I might say that it wasn't the intention when this paper was prepared to elaborate on system No. 3 or to give such detail as would allow a city like Toronto or Hamilton or other Utilities of like size, to take this system and install it in their own Utility as it stood. The main object of the paper was to set up a system for the smaller Utilities and give them suggestions of forms and other things that we are using, and while these forms perhaps would not answer the needs of the large cities, the majority of them will be found to answer all that is required by the smaller municipalities. I simply put in Chart No. 3 in order to complete the trend of thought.

Mr. John Taylor: (Hanover). In the case of a small municipality that combines both water and light under the one Commission, would they have to keep two systems, one for the light and one for the water? I notice the gentleman from London says they combine water and light together. In the case of one Commission would you have two separate accounts, one for water and one for light. Could they be combined?

Mr. Mickler: I might say that it is possible to incorporate the accounts of the waterworks and the electrical department into one and at the same time keep them entirely separate. It simply means keeping sufficient columns in your books to take care of what accounts you want to keep. Of course it has been ordered by the Hydro that all Hydro funds be kept separated from the water department's funds, and that doesn't leave very much choice in the matter. As a matter of fact you have got to keep the water works accounts entirely separate from those of the electrical department. It is unfortunate that such is the case, but experience has taught us that it really paid, and while the thing can be incorporated in one system it is better to keep them separate.

Mr. McCollum: (H. E. P. C.). I would like to point out to the delegates of the Convention that the points brought out by Mr. Mickler are fundamentals in the matter of accounting in connection with the sale of appliances and the carrying on of wiring business. To any person who hasn't been handling accounts covering such transactions it is bound to appear more or less confusing, but I would urge that the members who have the pamphlet take it home with them and study it and keep it available

for use when the time comes that they will need it. I think they will then come to find as they apply it step by step that it covers practically every transaction or problem which they will meet, and it will be a very valuable thing to have ready for the day of need.

MR. A. W. J. STEWART: (Toronto) I think it is advisable that return vouchers should be used for goods returned; it leaves the sale slips with nothing on them but actual sales and this saves a great deal of time when it becomes necessary to find something on these sales slips.

One point Mr. Mickler did not speak of occurred to me, and that is in connection with requiring customers purchasing on the installment plan to insure the articles until such time as they are paid for. There might be difficulty in collecting that insurance in case of a fire but the number of cases where it would be collected would warrant a Utility putting it in force.

We have eliminated two spaces in the form of agreement. Where you fill in the name of the purchaser in the body of the agreement we have eliminated that by putting in "On above goods." That makes two spaces fewer for the salesmen to fill in. We find it is hard enough to get them to fill in everything so we make as few spaces as possible.

MR. G. H. CLARK: (Kitchener). I would like to ask Mr. Mickler in regard to the return of goods taken out by the smaller municipalities that do not sell supplies to any extent. Certain supplies are used in construction and are taken out and perhaps not returned for several days. The trouble seems to be to keep proper return records of the articles which were actually used and returned, with a minimum amount of labor.

I would like also to ask you how often an inventory should be taken or how supplies should be kept so that an inventory can be taken. I think the difficulty of keeping supply accounts is to keep a proper record of the return of those supplies that are taken out and perhaps kept out for a week or longer and then are brought back. If you could give us any information about that I think it will perhaps help those who are in small municipalities and who don't go into this business to any extent.

MR. MICKLER: I think you can adopt practically the same scheme for the handling of construction and maintenance charges as is done with the contract and installment sales; that is, instead of a sales order a work order is made out. There would be a stores requisition made out when the material was taken out and another made out when the material comes back. It simply means a keeping together of these requisitions and entering them all up on the job order. It would be necessary to know what the men are going to do when they take material out, not simply allow them to take a waggon load out and say: "We are going to work such a street to-day." It should be known what material is needed for a certain job and then when it comes back the proper entries should be made. Things are not lost if they are remembered.

As far as an inventory is concerned, if you have a minimum amount of stock and keep a proper system of stock records you can take an inven-

tory at any time of the stock on hand. Suppose you had shown on a stock card one thousand feet of a certain kind of wire and you look in the stock room and find that you have nine hundred and ninety-five, you know the reason why. A general inventory should be taken twice a year in small municipalities.

MR. R. E. GARRETT: (Sarnia). Regarding the installment plan, I would like to know if it is the practice to have the monthly bill take care of the installments. I don't know whether it is customary in other places.

MR. MICKLER: We think the proper way to collect installments is through the medium of the monthly lighting bill. That means when there is a balance in the installments you can't very well pay your lighting account without paying the other. The teller should have instructions that he has no authority to change any bill. This can be carried out better where the teller is separate from the rest of the office. The manager is not around and the teller has no authority to change the account so there is nothing to do but pay it.

MR. H. F. SHEARER: (Smith's Falls). We undertook in starting our appliance department to use the system of separate accounts for the installments, but we found the same difficulty as a great many have found, that the customer would bring his lighting account with him but forget all about the installment account. We therefore arranged our bills to include the installment account with the lighting account. Just between the net amount of the lighting account and the arrears line we made a provision for an entry of the first, second, third or fourth, (as the case might be), payment of sales slip number "so-and-so." That is added in first, and then the arrears added to the net amount, which makes the total bill. There is no opportunity of getting a receipt for the lighting account until the installment account has been paid. This plan has worked out very satisfactorily and we have had no trouble to collect the appliances accounts.

THE PRESIDENT: Perhaps Mr. Hillman will have something to say on this subject.

MR. HILLMAN: The customer has agreed to pay his installments monthly and if he doesn't pay one month, the next month we send him a bill for two months. We add the other month on. The teller has positive instructions that he cannot alter any bill.

THE PRESIDENT: Do you find the customer comes in to pay the monthly installment or does he wait for the bill?

MR. HILLMAN: Most people prefer to wait for the bill.

MR. A. T. HICKS: (Oshawa). With regard to cash sales for small municipalities, is the cash register system believed to be an efficient one?

MR. MICKLER: I think the cash register leaves a loop-hole. As a matter of fact, the object of the cash sales slip is to provide a permanent office record of stock taken out of the store, and in using a cash register system the articles taken away would have to be put on the cash register slip which is not possible. You could not tell from a certain amount of cash on the cash register slip whether that represents the sale of an iron or the payment of an account, or lamps, etc.

In this manner the real object of the cash sales slip would be lost. Our prime object of using cash sales slips was to provide an absolute record of every sale and an absolute record of every item that left the store, as well as a medium for checking.

MR. HILLMAN: I might mention that in selling appliances under the installment plan, the installment price is different from the cash price. You have already added the interest to the cost of the appliance, so that we are not out anything by a person buying on the installment plan.

THE PRESIDENT: What do you do when there is no installment basis for the sale of the article? You say you had interest, what interest?

MR. HILLMAN: Six per cent.

THE PRESIDENT: On the gross?

MR. HILLMAN: Naturally, we add six per cent. to the sale price.

MR. SHEARER: Is there any limit to the time that you consider a cash sale as such, or do you consider that so long as you have to carry an entry through your installment accounts that the interest should be added to the sale price? What I mean to say is: So long as it is necessary to enter the sale in the installment records do you add the interest?

MR. STEWART: In cases like that, if the purchaser pays within thirty days he is entitled to the cash price. A great many people come in and they are not sure whether they want to pay cash or on the time basis. A great number buy on time and say they will most likely pay it all up within thirty days. Ninety-nine per cent. of them fail to do so, but if they say they have any intention of paying it within thirty days that is marked on the slip and they will have the advantage of the cash price if they do pay within that time.

MR. J. G. JACKSON: (Chatham). I would like to ask Mr. Mickler whether the form of lien note he suggested can be discounted in the bank?

MR. MICKLER: Well, not to my knowledge. The lien law says that a lien note is an ordinary promise to pay, and if a note is given for value I don't see why it wouldn't be accepted by the bank. Of course, that would be up to the bank. It is a note and I don't see why, because it is just a piece of paper that a man has signed his name to, that it is not just as good as a lithographed form of lien note. I would judge it would be as good as a promissory note, that is, on the installment plan. So far as the Bank is concerned, they would have to get their interest on the discount basis.

Ladder Hazards

A PARTY of workmen were installing transformers in a high tension station and in order to work on the top of the transformers had to make use of a ladder. This ladder was placed against the top of the transformers, the lower end being braced against a truck. One of the men ascended and when almost to the top, the ladder slipped around the transformer. The workman was thrown to the floor, falling about fifteen feet, severely injuring himself.

The ladder was again replaced, no

further precautions taken, and another workman ascended. Again the ladder slipped, and this man fell, striking his head on the base of the transformer, and narrowly escaping a fractured skull. At the time of writing he is still in the hospital.

Both of these accidents were clearly avoidable, and would hardly have happened if the ladder had been tied at the top as it should have been.

The cause of the first accident could be attributed to ignorance of the hazard; the second accident is a clear case of "I forgot" on the workman's part, or if he knew no better, lack of supervision on the part of the foreman.

Report of Committee on Accident Prevention

Mr. President and Gentlemen:

The members of this Association will remember that at the January Convention in Toronto a letter was received from the Hydro-Electric Power Commission of Ontario, requesting that we co-operate with the Central Accident Prevention Committee of the Ontario Commission with reference to safety in the operation of the various Municipal Systems as well as the Ontario System. At that Convention a committee was appointed to meet the Central Accident Prevention Committee, consisting of Mr. E. I. Sifton, Mr. E. V. Buchanan, and myself. Your committee met with the Central Accident Prevention Committee on April 9th, and a resolution was drafted bearing on this subject, which resolution was introduced at the last executive meeting of this Association. Your Executive saw fit to introduce the resolution and to pass the same on for the adoption at this Convention.

The following is the resolution as it now appears:

That "This committee considers it essential for the safety of employees of both the Provincial Commission and the Municipal Commissions that the operators, linemen, station maintenance men and other employees of the municipalities and of the H.-E. P. C. which have occasion to work on lines or apparatus, should have a thorough and complete knowledge of the methods and procedure to be followed in obtaining clearances for work on such lines or apparatus and for returning such clearances and placing lines or apparatus back into service. This should include knowledge at all times as to what officials or employees have authority to give clearances on lines or apparatus in the locality; knowledge as to the points from which the different lines or apparatus are supplied with power, or from which they might be made alive; knowledge as to the proper and universal designation of each line, line section or piece of station apparatus in that district, and also as to any special conditions affecting clearances.

It is therefore recommended that the Hydro-Electric Power Commission of Ontario be given authority to examine in conjunction with an authorized representative of the local Commission, local operators, linemen, and station maintenance men and other employees having occasion to work on or near operating lines and apparatus connected with the Com-

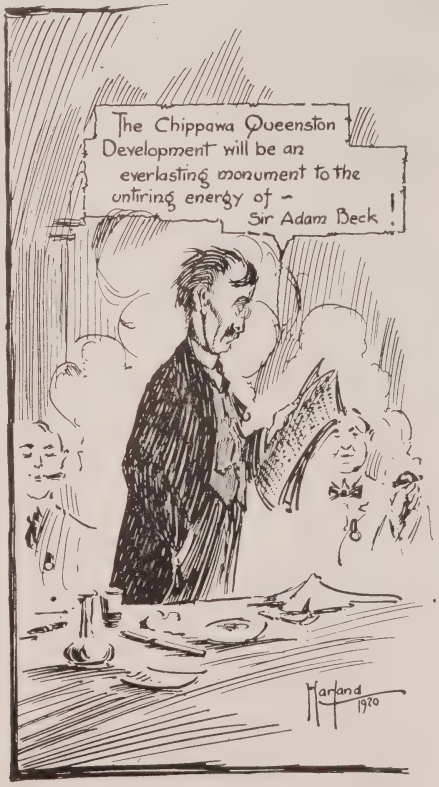
mission's systems, as to their knowledge on such points as outlined above and that the Hydro-Electric Power Commission of Ontario recommend and, if necessary require, the municipalities to employ and retain only such men as have a complete and thorough knowledge of such matters."

I believe that the adoption of some such system of inspection and examination as outlined above would be of inestimable value to the various municipalities. It would certainly help to prevent misunderstandings and consequent accidents in connection with obtaining clearances for work on lines and apparatus and in placing such lines or apparatus back into service. I therefore take pleasure in moving that the Association of Municipal Electrical Utilities endorse and adopt this resolution.

It was suggested that this Association appoint a standing committee who would co-operate with the Central Accident Prevention Committee of the Ontario Electric System in the formulation and adoption of such measures as will put this scheme into operation.

I would suggest that this committee be appointed now.

M. J. McHENRY.



Metering the Consumer's Load

By Paul M. Lincoln

Lincoln Electric Co., Cleveland, Ohio

IT IS a trite saying that the luxuries of yesterday become the necessities of to-day. This saying is true of nothing more thoroughly than of electric service. The first commercial use for electricity was for arc lighting and the first commercial arc lamp was put into operation less than 45 years ago; the incandescent lamp is scarcely 40 years old. While electric power service was used to a limited extent during the late eighties and early nineties of last century, such service in the modern sense may truly be said to have began with the inception of the Niagara Falls Power Company which began commercial operation during the summer of 1895, or less than 25 years ago. Within my own lifetime, therefore—in fact, within a space of time but little longer than my professional career—electric service has become transmuted from a luxury into a necessity. Power is as essential to modern industry as is the blood to a man, and the electrical method of generating, transmitting and distributing such power has so many advantages over other methods that it is fast superseding all other methods; in fact, industry has come to be so dependent on electric power that it would become well nigh helpless without it.

Further, the business of furnishing power to our modern industries has come to be recognized as one distinct and apart from the industry itself. Power can be more cheaply and efficiently generated, transmitted and distributed in large quantities than in small. Hence, few modern industries can afford to manufacture their own power when central station power is available. As a result, the tendency in the past has been and undoubtedly will continue to be toward the elimination of the isolated plant and the extension of central station service. In my own mind there is no doubt but that this is logical and is justified by the fundamental consideration noted above, viz.; that power can be generated, transmitted and distributed more economically in large volume than in small.

The specialization of the business of generating, transmitting and distributing electric service brings with it, of course, the problem of rates for the sale of such service and this in turn entails the problem that I have

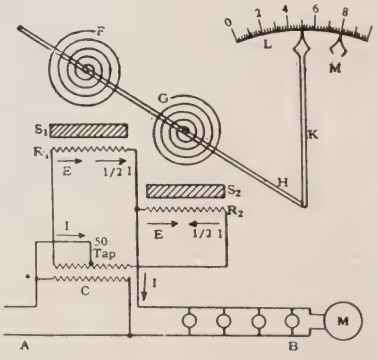


Figure 1.

made the subject of this paper, "Metering the Consumer's Load." It might be well first to review briefly the question of rates for electric service from a historical viewpoint.

The first commercial use of electric service was for arc lamps and these have almost invariably been restricted to street illumination. From the beginning, when arc lighting service has been rendered, it has been customary to base the rate upon the lamp-year as a unit. This basis has proved entirely satisfactory for this specific kind of service; incidentally also, the rate usually includes the upkeep of the lamps and other equipment necessary to render the service. In this case, it is not electric service that is bought and sold so much as it is a certain unit of light and usually for a certain specific duty. When bought and sold on a basis of light, rates for the electric service used in arc lighting becomes a relatively simple matter, and if all electric service were restricted to arc lighting, there would be no "rate problem." With the introduction of the incandescent lamp during the early eighties of last century, the problem of rates for electric service became somewhat more complex. At first, the methods of selling service for incandescent lamps were the same as for arc lamps, that is the so called "flat rate" or a certain fixed amount for each lamp per month. Soon, however, it was recognized that it was illogical not to consider the length of time during which the lamps were burned and the first electric meters were introduced.

The first meters used were on direct-current circuits and depended on the amount of metal deposited by the electrolytic action of the load current; these were, therefore, ampere-hour meters and the design and construction of the first of these were due to Thomas A. Edison. This type of meter was objectionable from a number of standpoints and did not last long after Elihu Thomson brought out the watt-hour meter that bears his name. With the advent of the alternating-current, Schallenberger accomplished for that system what Thomson had already done for the direct-current system and service from both systems was sold thereafter on a watt-hour basis. The use of the watt-hour or kilowatt-hour basis for selling electric service was a vast improvement over the flat-rate method that had been used previously and if electric service had always been restricted to lighting there would be no particular need for any measurements other than the kilowatt-hours. Early in the nineties of last century, however, the use of electric service for purposes other than lighting began to be recognized as increasingly important; electric service for power, electrolytic reduction and furnace work began to overshadow the electric light. At this period, began the era of the motor-driven factory, the electrolytic reduction of aluminum, the electrolytic purification of copper and the manufacture of carborundum and calcium carbide in the electric furnace. The use of electricity began to become more general than before; it was no longer simply a source of light as it was at the beginning, but a general service available for almost any purpose at any time. Then it began to be recognized that measurement of kilowatt-hours alone was not enough to give a logical basis for the fixing of rates for electric service. It

began to be recognized that load factor as well as kilowatt-hours of consumption must be taken into account in arriving at an adequate rate for such service.

Fixing a rate for electric service that is based on simply the kilowatt-hours of consumption is closely analogous to the problem of fixing the rental of a house or an office based on simply the "man-hours of occupancy," if we may be allowed to coin such an expression. A perfectly just and logical basis for the amount of rent to be paid can be arrived at if we know the "man-hours of occupancy," provided we also have reasonably accurate information concerning the habits of the occupants. So also, a perfectly just and logical basis for the rates for electric service can be arrived at from the kilowatt-hours of consumption alone, provided we know the load factor (habits) of the load taken. However, if the occupants of our house or office begin to spend a larger part of each day indoors, it is evident that our former basis of rental becomes illogical. So also with the user of electric service; if he should begin to use his service for more hours per day, the rate that was established formerly would no longer remain logical. In other words, load factor must be taken into account if we would have a just and logical rate.

However, justice and logic are not the only criteria by which to judge a rate. The question of the cost of obtaining the information upon which the rate is based is one of the utmost importance. Even under present conditions, the cost of securing and handling the information necessary for billing purposes constitutes a very considerable part of the total cost of rendering electric service, particularly to residential consumers. Therefore, any plan that causes a very material increase in this cost, even though it makes for a more logical and more just rate, cannot be tolerated.

More than thirty years ago, or, to be more specific, in the year 1883, Dr. John Hopkinson of England first suggested the use of "maximum demand" as an item of first importance in the schedules of rates for such service. In his presidential address before the Junior Engineering Society (British) on November 4, 1892, on the "Cost of Electric Supply," he elaborated his ideas on this subject. So clearly did he show therein that the maximum demand, in addition to the number of "units' (kilowatt-hours) used is absolutely essential in arriving at the cost of supplying electric energy, that ever since, any method of fixing rates that involved the use of maximum demand has been known in general as the "Hopkinson method."

Since Hopkinson's first suggestion, there has been much discussion on this question of rates. Papers almost without number have been written on this subject of rates and every phase of the matter has received critical attention. For the past ten years the National Electric Light Association (U. S.) has issued a weekly bulletin entitled *Rate Research*, and devoted to nothing else but a discussion of rates and closely allied subjects. Without exception, all authorities have recognized the correctness of Hopkinson's main contention, viz., that any logical rate for electric service must, in some manner, recognize maximum demand as well as the total kilowatt-

hours of energy used, thereby taking load factor into account.

When we come to consider the question of how this maximum demand of a customer for rate-making purposes shall be obtained, we are at once faced with the fact that in general *it is not obtained.* When I say it is not obtained, I mean it in a relative sense. The electrical industries of Canada and the United States now absorb watt-hour meters at the rate of well over one million per year. The use of the maximum demand indicators of all types and descriptions probably does not exceed more than a fraction of one per cent. of this number and therefore in only this small fraction of the customers for electric energy is any *direct* attempt made to apply the Hopkinson method of charge. The watt-hour meter has admittedly reached a stage of development that leaves but little to be desired. The modern watt-hour meter is accurate, cheap and relatively easy to maintain. However, it gives only one of the items of information that enters into a logical system of rates and makes no attempt to furnish any other.

"Hopkinson method" is a generic and not a specific term. There are many varieties of "Hopkinson methods." The inherent complexity of the rate question together with the long absence of any adequate method of measuring maximum demand has led in many cases to the practice of inferring the maximum demand instead of measuring it. In some cases for instance, it is the practice to base the maximum demand on the summation of all the name plate ratings of the motors connected. There are many objections to this practice. In the first place, it tends toward the installation of motors too small for their work with consequent motor trouble. Next, it makes for the misbranding of motors in placing name plates on them smaller than their actual capacity. Motor manufacturers are often asked to alter name plates for the purpose of its influence on the prospective customer's power bill. Next, it discourages individual drive for motor driven appliances. Individual drive is coming to be recognized as best practice, and it is unfortunate, to say the least, that we should have another influence running counter.

Next, it is coming to be the practice of guaranteeing no overloads on motors and here again this practice runs counter to that of basing maximum demand on name plate rating. Again, the practice recognizes motors only and in this day of growing popularity of electric furnaces, heating devices and the many methods of using electric service, a method of inferring maximum demand that rests on the name plate rating of the motors is deficient. Then finally, it is not a users potentiality to use power that should fix his maximum demand, but his actual use. Maximum demand should be measured, not inferred.

The first device that sought to fill the need first pointed out by Hopkinson was the so-called Wright Demand meter. This device was patented by Arthur Wright of England in 1893 and first appeared on the market about 1896 or 1897. This was an ampere demand meter and not a watt-meter; it, therefore, suffered the fatal defect that it recognized amperes of

demand instead of watts and therefore penalizes the user of power whenever the voltage is low. The user is not responsible for low voltage and therefore the system of rates based on amperes of demand instead of watts inflicts a penalty for a condition for which the user is not responsible—a position that is quite untenable for a supplier of power. In addition, the Wright meter as designed and used had no method of compensating for the heat that flowed into or out of the active air chamber due to heat conduction in the lead wires. Judging from the results of tests, this defect alone is apparently sufficient to condemn the device independent of the consideration that it is an ammeter instead of a watt-meter.

There are three recognized types of demand watt-meters in use to-day. They are:

1st—The Thermal Storage Type.

2d—The Mechanically Lagged Type.

3d—The Merz or Block Interval Types.

The characteristics of these types will be described in the order named.

1st—The Thermal Type.

The theory and characteristics of this type are fully given two papers by the author in the A. I. E. E. proceeding of October 8, 1915 and February 15, 1918. Some of the material from these two papers is quoted in this paper.

The operation of the thermal watt-meter is shown diagrammatically in Figure 1, in which A is a single-phase circuit feeding a load B. A small transformer C is incorporated within the meter with its primary across the circuit A. In series with the secondary of this transformer are two equal resistances R_1 and R_2. A current is of course set up in these resistances that is proportional to the voltage of the circuit A. The load current is also caused to circulate through these same resistances as shown in Figure 1, being taken into the middle of the secondary or the small transformere and out at the connection between resistances R_1 and R_2. These two current—one the secondary current, due to the presence of the voltage and the other due to the passage of the load current—are additive in one of these resistances and subtractive in the other, and the difference in the heating effect of the two resultant currents is proportional to the wattage of the load B.

If the current that passes through the resistances R_1 and R_2, due to the presence of the voltage, is represented by E, and the load current therein by I, the resultant current in one of these resistances is E plus $\frac{1}{2}$ I, and in the other E minus $\frac{1}{2}$ I. The difference of the losses in R_1 and R_2 is proportional to the product EI.

F and G represent two spiral springs made from bimetallic strips, attached rigidly to their casings at the outer ends and to a common shaft H at their inner ends. These bimetallic springs tend to uncoil on an increase in temperature (due to the difference in temperature coefficient of the two metals of which they are composed) but, since the two springs are wound in opposite directions, no movement of the shaft H will take

place unless there is a difference in temperature between F and G. The shaft H, therefore, will not turn with changes in atmosphere temperature or with any other condition that causes both springs to maintain the same temperature, but will respond only to the difference in temperature caused by the difference in the losses in resistances R_1 and R_2. S_1 and S_2 represent diagrammatically the thermal storage of the cases in which the bimetallic springs F and G are enclosed. Due to this thermal storage, the watt-meter does not respond instantly to a change in load but always indicates the logarithmic average load over the time period immediately preceding the instant of observation, the length of this time period being determined in part by the amount of thermal storage of the cases. K is a pointer attached to shaft H and travelling over the scale L. M is a friction pointer which shows the highest position of pointer K since last reset.

That the indications of such a device will correspond to the watts independent of power factor is indicated graphically in Figure 2. Suppose AB, Figure 2, is the value of the current that flows through the resistances R_1 and R_2 due to the secondary voltage E in the transformer C of Figure 1. Suppose further that CD, Figure 2, represents both in magnitude and phase angle the load current I that flows through these same resistances. It is obvious that the resultant current in resistance R_1 is proportional to the distance AC Figure 2 and that in R_2 is proportional to AD. If AB and CD are in phase the resultant currents are respectively $E+\frac{1}{2}I$ and $E-\frac{1}{2}I$. Since the heating effects are proportional to the squares of these values, the indication on the scale is proportional to $(E+\frac{1}{2}I)^2-(E-\frac{1}{2}I)^2=2EI$. If AB and CD are 90 degrees out of phase with each other, it is obvious that the two resultants will always be of the same value. For any other angle, or for any wave shape, it can be proved mathematically* that the watts are proportional to AC^2-AD^2 and this is the value that is measured by the thermal demand meter.

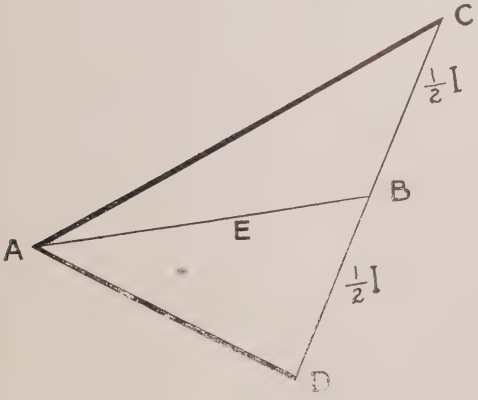


Figure 2

The quantity measured by the thermal storage demand meter is the average watts over a certain time previous to the instant of observation, rather than the instantaneous watts measured by an ordinary watt-meter. Further, the average so measured is not the arithmetical average but what is called the "logarithmic" average. In other words, the indication of a ther-

* Such proof is given in Appendix II of a paper entitled "Rates and Rate Making" Trans. A.I.E.E., Oct. 8, 1915, Vol. XXXIV., p. 2313.

mal storage watt-meter is not that due to the watts pasisng at that instant, but is the resultant of all the wattage flow that has passed, each instant of past flow having a value influenced in respect to its time proximity by a logarithmic law. When the word average is used in its commonly accepted sense, it is assumed that each instant of time over which the average is taken has equal weight. In the resultant that is obtained by a heat storage meter, each instant of time has not an equal weight, but the influence of each instant decreases with its remoteness in point of time, and the degree by which the watts during any instant influences the total indication is proportional to e-KT where e is the base of Napierian logarithms, K is an adjustable constant, and t is the time measured backward from the instant of observation. For steady loads, the logarithmic and arithmetical averages are the same. The same is true where the load is fluctuating provided the fluctuations in load are comparatively rapid. For instance, if the load fluctuations are continuous and do not exceed two minutes in duration on a thirty minute meter, the results on the logarithmic and arithmetical average meters are the same. For isolated peaks of load, the logarithmic average meter responds to the increment of load in excess of the previously existing steady load in a manner that will give results close to but not necessarily identical with the arithmetical average. For instance, the arithmetical average or an isolated peak load for a time duration of more than about 26 minutes will be greater than the registration of a 30 minute thermal demand meter, the maximum value of the difference bein 10 per cent. of the increment of the peak load over the previously existing steady load, as shown in Figure 3. For peak load durations less than about 26 minutes the arithmetic average will be less than the logarithmic average registered by the thermal

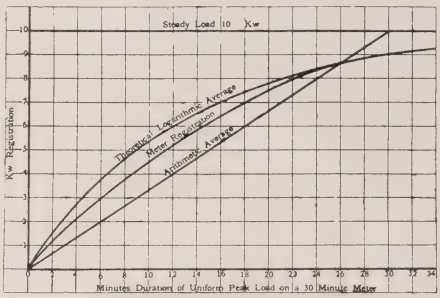


Figure 3

meter, the percentage difference increasing as the duration of peak load decreases as shown in Figure 3. For example, if a 10 K.W. load is applied to a 30 minute thermal demand meter for five minutes, it will register —providing the previous load has been zero—about 2.64 K.W. of demand while the arithmetical average of that same five minute peak over the 30 minute period would be 1.67 K.W. If the peak should last for twenty minutes instead of five minutes, the thermal meter would register approximately 7.54 K.W. of demand as against 6.67 K.W. by the arithmetical meter. As indicated above, at about twenty-six minutes of load duration, the indications of both types of meter would be identical. In brief, for a short time duration of peak load, the arithmetical average is lower than the logarithmic average; for longer periods of time, the arithmetical average is slightly higher than the logarithmic average; while

for very long durations, exceeding twice the time period of the meter, there is no appreciable difference. The logarithmic characteristics of the thermal demand meter is of advantage, because such a device recognizes the heating and this is the quantity after all that should be recognized, since it is that which fixes the limiting capacity of the equipment necessary to furnish the service.

If the character of load is known, the indications of a thermal storage demand meter can be determined by analysis in the manner outlined in the 1918 volume of the A.I.E.E. transactions, pages 162-165. The results of such an analysis on certain specific types of load are given later in this paper.

2nd—The Mechanically Lagged Type.

In this type, an indicating watt-meter of any standard type is associated with a standard watt-hour meter in such a way that the indications of the indicating watt-meter are delayed by the action of the watt-hour meter. An escapement is attached to the indicating watt-hour meter so that it cannot advance instantly as in the usual meter but can advance only a certain definite amount for each revolution of the watt-hour meter. A ratchet is provided so that the indicating watt-meter may recede instantly but the next advance when it occurs is again retarded by the watt hour meter. The characteristics of this meter therefore, are that it will always advance at a rate proportional to the total load passing while it recedes instantly. The characteristic of advancing at a rate proportional to the total load instead of the increment of load causes this meter to read high whenever short time increments load are superimposed on a previously existing steady load and the characteristic of receding instantly causes it to read low whenever the load is such that it returns to zero or some other low value. The Westinghouse type "RO" demand meter is the only one of this type that has been manufactured to date.

If the character of the load is known, the indications of this type of meter can also be determined by analysis. The results of such an analysis on certain specific types of load are given later in this paper.

3rd—The Merz or Block Interval Type.

In this type of demand meter a standard watt-hour meter is associated with a clock or other timing device in such a way that the number of revolutions of the watt-hour meter disc during some definite interval of time are determined by the device; at stated intervals a definite and fixed time apart the clock or other timing device sets a register back to zero. The watt-hour meter then advances this register during the ensuing time interval. At the end of the interval the clock or other timing device again resets the register to zero and the process of advancing begins again. A maximum register indicates at the end of the month the maximum advance that has taken place during the month or since last reset. The inherent defect in this type is that it may "split" the peak when the time duration of the peak is less than the

time interval of the meter. The Merz or block interval type of demand meter therefore, measures the arithmetical average of the watts over a definite time interval but the maximum time interval so measured might not correspond with the actual maximum. It, however, has the vital advantage that its indications are "safe." If any device used in determining a customers bill favors the company supplying the service, it can be successfully attacked by the customer while if the contrary is true, it cannot. Hence, the indication of this type of demand meter are "safe" since it cannot over register. Another disadvantage of the "block interval" demand meter is that two or more of them applied to the same load will rarely check each other. This characteristic follows from the fact that it is impossible to synchronize the clocks or other timing devices used with these meters and therefore, the time intervals of the various meters do not correspond. The actual peak may be split in various ways by the various meters used and hence the readings will not correspond.

The best method of visualizing just what these various types of meters will indicate is to show by analysis what each type will read with a definite and specific character of load applied. In Figures 4 to 16 inclusive, this is done for thirteen definite types of load. The number of possible types of load is of course infinite and it is impossible to consider them all. However, the types considered in Figures 4 to 16 are more or less typical of actual loads and at least will give a general idea of what each kind of meter will do on a given kind of load.

The type of load considered in Figures 4 to 8 is a continuous steady load with superimposed peaks of certain definite character. All load values are so chosen that the arithmetical average over the maximum thirty minutes is 100 per cent. Thirty minutes has been taken because the results of these particular loads have been carefully checked on a thirty minute thermal meter. The results are relatively the same on a ten minute period as these figures show for a thirty minute. In general, for this type of load, the thermal demand meter reads slightly above the arithmetical average, by an amount depending on the increased heating effect caused by the superimposed peaks; the mechanically lagged shows an excessive over registration; the block interval meter shows the arithmetical average over thirty minutes with a "coefficient of indefiniteness" that increases with the amount of the superimposed peak.

Figures 9 to 13 show the results of the various types of meters with isolated blocks of load of various times of duration. Here again the arithmetical average of the block is selected so as to be 100 per cent. over a thirty minute period; the results however, would be relatively the same if any other time periods were considered. In general, for this type of load, the thermal meter reads higher than the arithmetical average—except Figure 13—and the excess in each case is due to the higher heating effects of short time high peak loads; the mechanically lagged meter reads the exact arithmetical average; the

"block interval" meter read the arithmetical average as a maximum and has a "coefficient of indefiniteness" of 50 per cent. It will be noted that the excess of the thermal meter over the arithmetical average is very marked when the demand is confined to a short interval. For instance, in Figure 9 a load of six times normal for one sixth of the normal time period is shown and in this case the thermal meter reads 158 per cent. of the arithmetical average. I consider this a perfectly logical result since the heating effect of a load of six times normal for one sixth the normal time is much greater than if a normal demand had been spread over the entire thirty minutes. A customer who insists on taking his entire thirty minutes quota of power in five minutes and then takes nothing for the other 25 minutes obviously should be penalized for taking his load in this way. The thermal meter inflicts this penalty automatically; it recognizes the true heating effect of a given load no matter how it is taken.

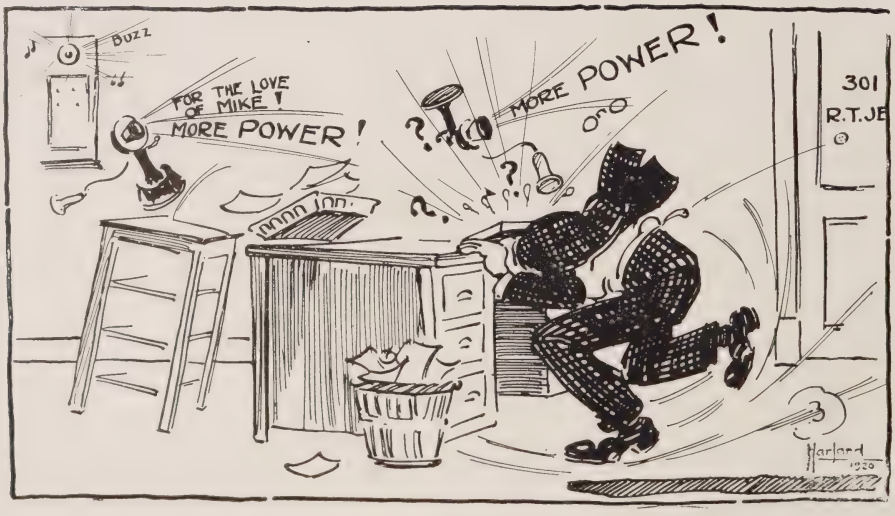
Figures 14 to 16 show the results on the various types of meters when the load is constantly fluctuating over wide limits. Here again the arithmetical average over the maximum thirty minutes is 100 per cent. but the results would be relatively the same on any other time period. In general, the thermal meter reads slightly above the arithmetical average—the excess being governed by heating effect as in the other types of load; the mechanically lagged meter reads only a fraction of the arithmetical average load; the block interval meter reads the arithmetical average as a maximum and has a "coefficient of indefiniteness" which is considerably affected by the exact character of the load. The low reading of the mechanically lagged meter is due to the characteristic that causes it to follow a receding load instantly.

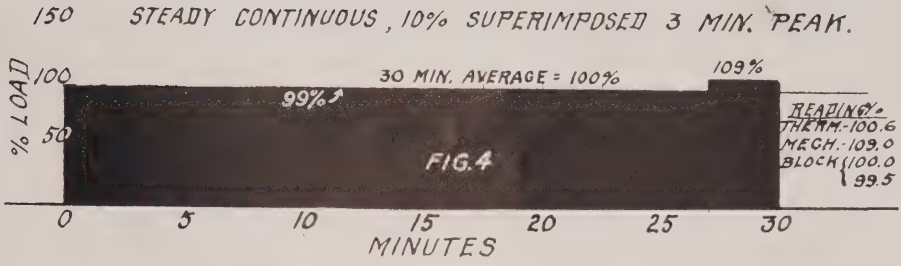
While many other types of load might be shown, it seems that these thirteen examples will give a sufficient idea of the characteristics of the various types of meters to enable prospective users to judge of their respective merits. Actual tests with meters of various types and on various time periods on loads of various kinds would be highly interesting and it is hoped that such tests can be made.

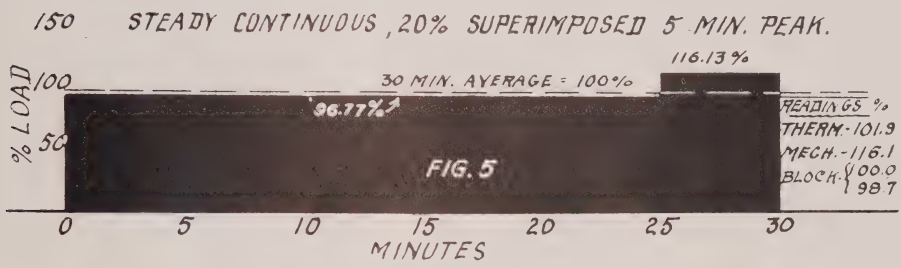
There is one further point that deserves some discussion before this paper is closed. One can logically take the stand that if the heating effect of a given load over a specified time period is to be taken as the basis of maximum demand measurement, then power factor certainly should be considered also in arriving at the demand. In other words, the demand should be based on K.V.A. instead of K.W. This I am perfectly willing to admit. The difficulty comes in measuring K.V.A. of demand instead of K.W. There are methods now in use of measuring K.V.A. of demand but they are very expensive methods and it is only the largest customers that bring in a sufficient revenue to justify the measurement of K.V.A. While it is quite possible that the cost of measuring the K.V.A. of demand can be brought to a lower figure than at present, it also seems that the measurement of the K.V.A. of demand will always be many times more expensive than the measurement of

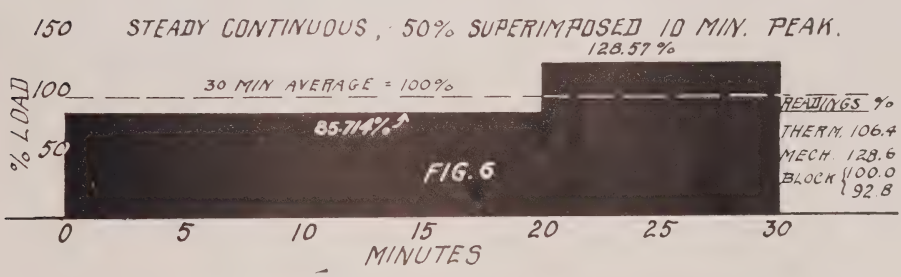
K.W. I see no prospect that this situation will ever change. It is therefore, my recommendation that programs for the measurement of demands shall not be held up awaiting the appearance of a device to measure the K.V.A. of demand. There is no doubt that such a device is coming and that it will appear shortly; there is also no doubt but that its costs will put it beyond the reach of all but the largest users of service. The ability to measure K.W. of demand both accurately and cheaply is now here and this ability should be made use of. We must govern our conduct not by the ideal but by the actual. The ideal is the measurement of demand on a K.V.A. basis; the actual is that while this is possible, its cost is so high that it is inapplicable to all except the more important customers.

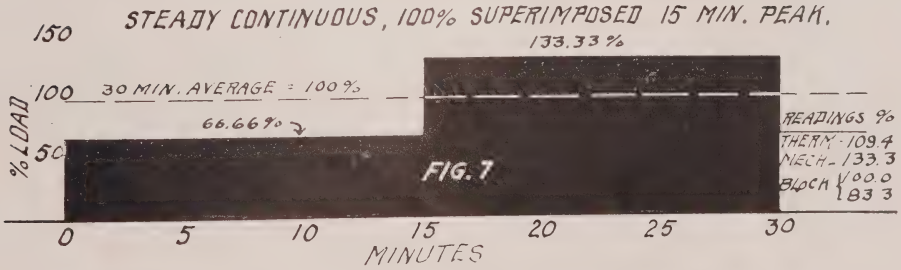
(See following pages for Figures 4 to 16)

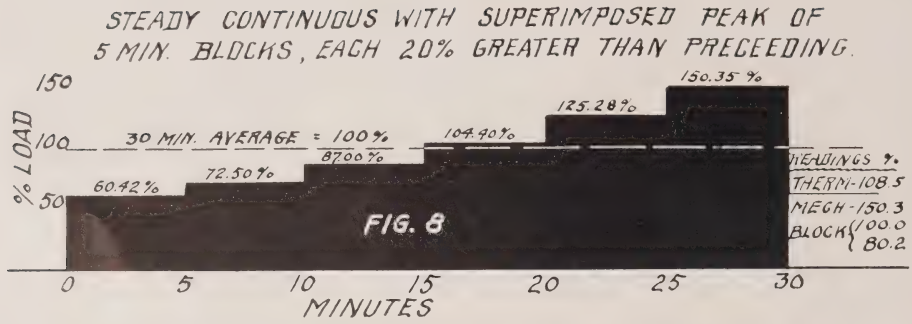


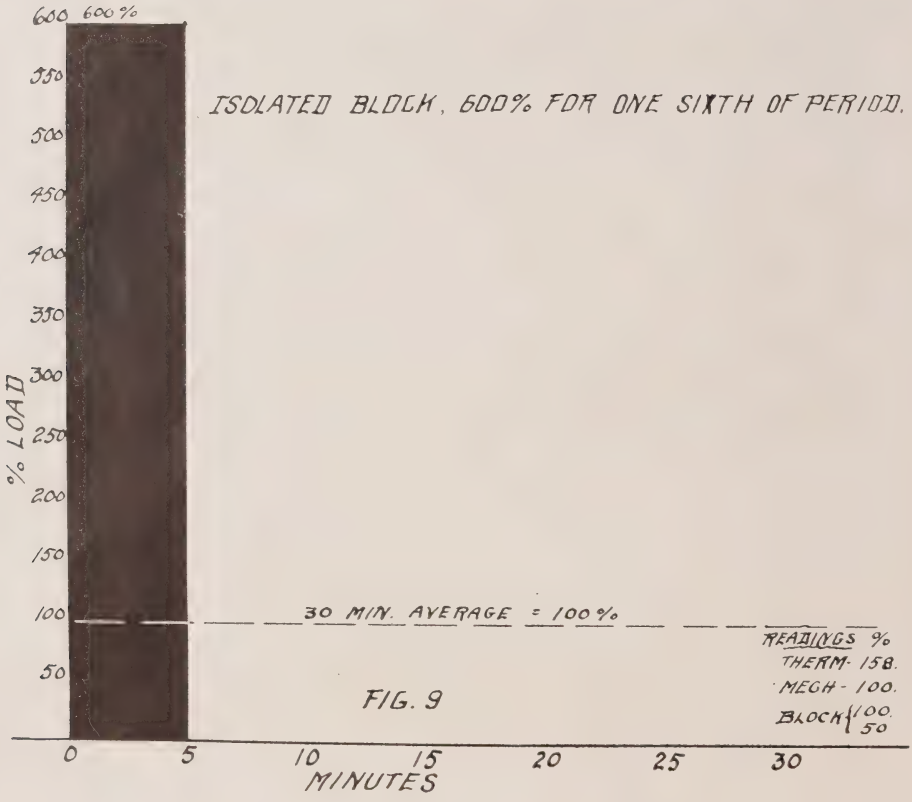

150
STEADY CONTINUOUS, 10% SUPERIMPOSED 3 MIN. PEAK.
% LOAD
100
50
30 MIN. AVERAGE = 100%
99%
109%
FIG. 4
READINGS %
THERM.-100.6
MECH.-109.0
BLOCK {100.0 99.5
0 5 10 15 20 25 30
MINUTES


150
STEADY CONTINUOUS, 20% SUPERIMPOSED 5 MIN. PEAK.
% LOAD
100
50
30 MIN. AVERAGE = 100%
116.13%
96.77%
FIG. 5
READINGS %
THERM.-101.9
MECH.-116.1
BLOCK {100.0 98.7
0 5 10 15 20 25 30
MINUTES

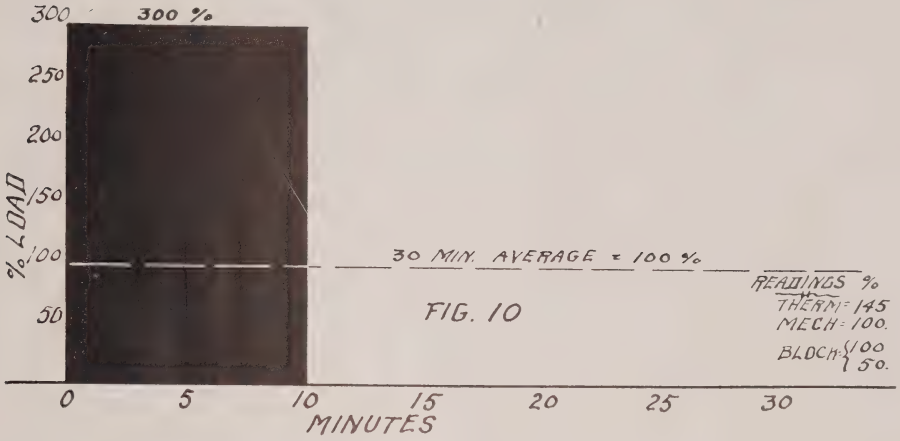

150
STEADY CONTINUOUS, 50% SUPERIMPOSED 10 MIN. PEAK.
% LOAD
100
50
30 MIN. AVERAGE = 100%
128.57%
85.714%
FIG. 6
READINGS %
THERM. 106.4
MECH. 128.6
BLOCK {100.0 92.8
0 5 10 15 20 25 30
MINUTES


150
STEADY CONTINUOUS, 100% SUPERIMPOSED 15 MIN. PEAK.
% LOAD
100
50
30 MIN. AVERAGE = 100%
133.33%
66.66%
FIG. 7
READINGS %
THERM.-109.4
MECH.-133.3
BLOCK {100.0 83.3
0 5 10 15 20 25 30
MINUTES

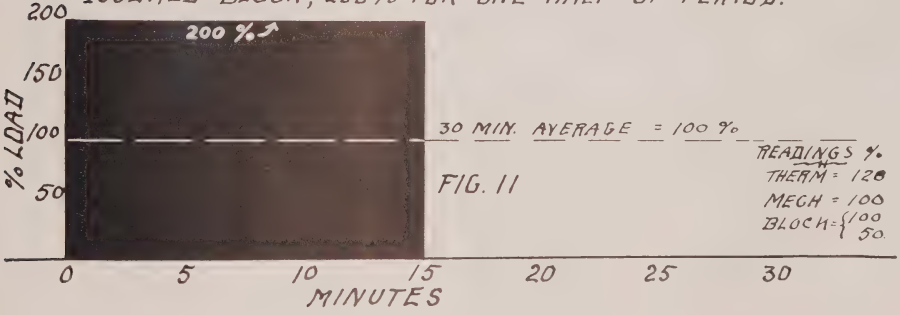

STEADY CONTINUOUS WITH SUPERIMPOSED PEAK OF
5 MIN. BLOCKS, EACH 20% GREATER THAN PRECEEDING.
150
100
50
% LOAD
30 MIN. AVERAGE = 100%
60.42%
72.50%
87.00%
104.40%
125.28%
150.35%
READINGS %
THERM-108.5
MEGH-150.3
BLOCK {100.0 80.2
FIG. 8
0
5
10
15
20
25
30
MINUTES


600 600%
550
500
450
400
350
300
250
200
150
100
50
% LOAD
ISOLATED BLOCK, 600% FOR ONE SIXTH OF PERIOD.
30 MIN. AVERAGE = 100%
READINGS %
THERM-158.
MEGH-100.
BLOCK {100. 50
FIG. 9
0
5
10
15
20
25
30
MINUTES

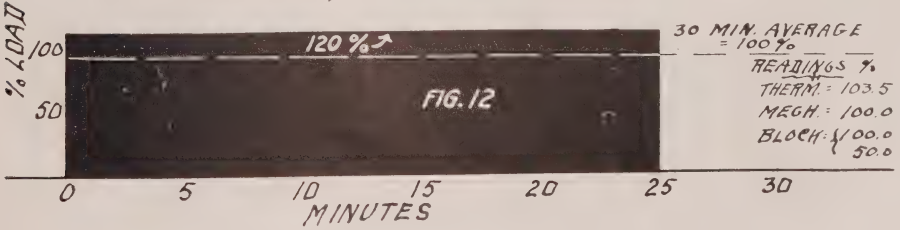
ISOLATED BLOCK, 300% FOR ONE THIRD OF PERIOD.

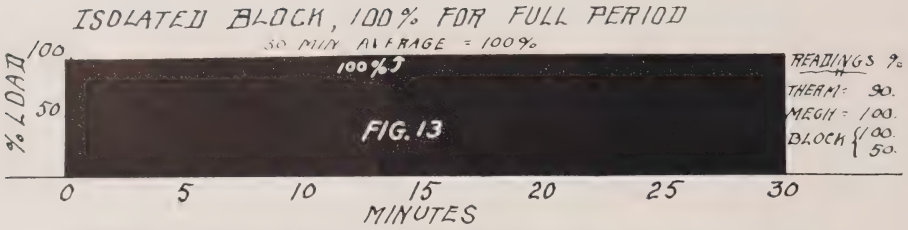


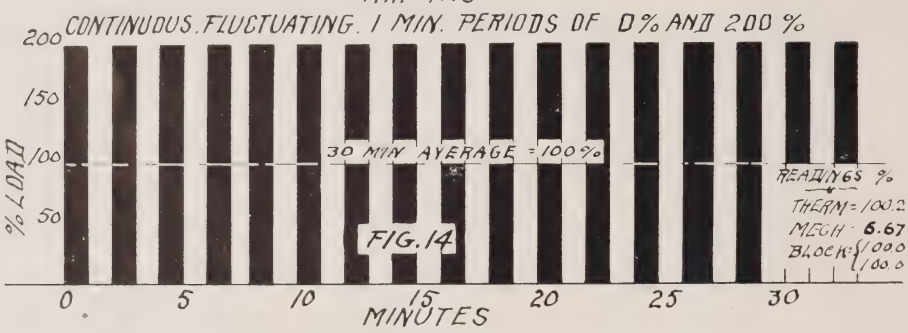
ISOLATED BLOCK, 200% FOR ONE HALF OF PERIOD.

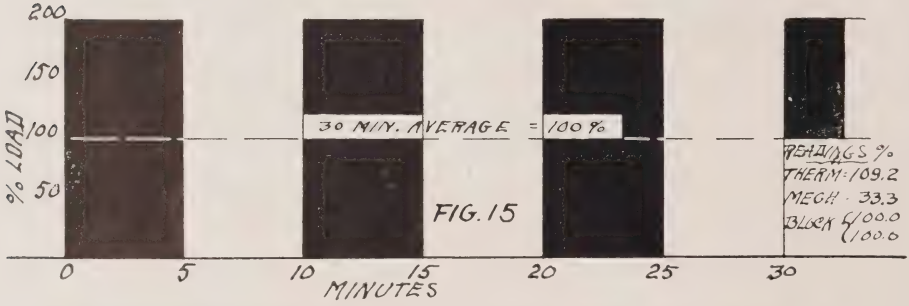


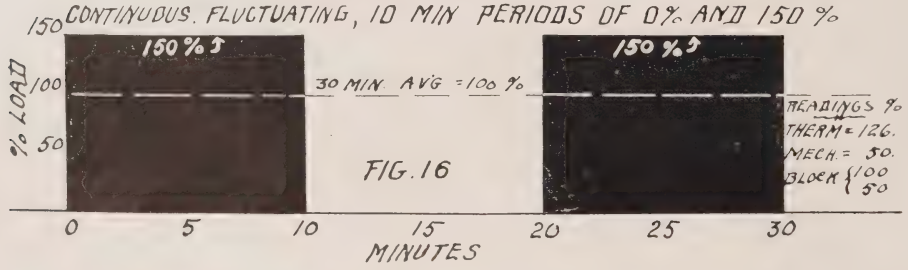
150 ISOLATED BLOCK, 120% FOR 83.3% OF PERIOD.




ISOLATED BLOCK, 100% FOR FULL PERIOD
30 MIN AVERAGE = 100%
100%
% LOAD
100
50
FIG. 13
READINGS %
THERM = 90.
MECH = 100.
BLOCK { 100.
50.
0 5 10 15 20 25 30
MINUTES


CONTINUOUS, FLUCTUATING, 1 MIN. PERIODS OF 0% AND 200 %
200
150
100
50
% LOAD
30 MIN AVERAGE = 100%
FIG. 14
READINGS %
THERM = 100.2
MECH = 6.67
BLOCK { 100.0
100.0
0 5 10 15 20 25 30
MINUTES


CONTINUOUS, FLUCTUATING, 5 MIN. PERIODS OF 0% AND 200 %.
200
150
100
50
% LOAD
30 MIN. AVERAGE = 100 %
FIG. 15
READINGS %
THERM = 109.2
MECH = 33.3
BLOCK { 100.0
100.0
0 5 10 15 20 25 30
MINUTES


CONTINUOUS, FLUCTUATING, 10 MIN PERIODS OF 0% AND 150 %
150
100
50
% LOAD
150 %
150 %
30 MIN AVG = 100 %
FIG. 16
READINGS %
THERM = 126.
MECH = 50.
BLOCK { 100
50
0 5 10 15 20 25 30
MINUTES

Discussion Following Mr. Lincoln's Paper

MR. R. G. LEE: (Toronto). The demand for power has grown to such an extent in these days that it is necessary that the demand must be be measured and in a way that will be fair to the customer and fair to the power company. There are two methods of measuring maximum demand, one is periodical test from time to time with a watt-meter and the other is by a permanently installed maximum demand system. The first method can be taken as a true basis as very often customers increase their maximum demand without mentioning it to the power plant. That is done sometimes through oversight and sometimes with intent. A station department will very often advise the central power station that there is a certain amount of maximum demand in a certain part of the city and then it is up to the Central Station to find it. This is very difficult and sometimes it takes weeks of investigation to find out just where the increase of maximum demand is. Of course if it were allowed to stand after the Station is advised of the increase it would be unprofitable to the Central Station, consequently, it is necessary to put on a system that is economical and yet that will give as nearly as possible a high grade efficiency of results, and I think Mr. Lincoln is to be complimented in putting on the market an instrument which will do this work and do it, I might say, in ninety-six per cent. of the cases in a manner which is both satisfactory to the Station and to the customer.

I might mention two or three of the examples which have come to my attention in the handling of maximum demands in Toronto. I will omit the names of the concerns for various reasons. There was one case where a maximum demand of forty horsepower was being paid monthly by a concern. A maximum demand meter was installed and at the end of the month a maximum demand was read as sixty horsepower. The customer immediately raised a complaint with us. I had faith, of course, in the maximum demand instrument and endeavored to satisfy the customer that he must have some increase of power which would show that demand. He was determined I was wrong and I thought that here was a case where either my faith in the maximum demand meter was lost or I would be satisfied that he was using more power. Finally a maximum demand meter was placed alongside the graphic wattmeter and for the first week nothing happened; both instruments remained at about forty. About three o'clock, however, one afternoon, we noticed a rise of the extra twenty horsepower. We did not tell the customer this but carefully investigated the cause. I had a man stay in the customer's plant, unknown to him, for two days watching the various processes of his manufacture. As a result of that we discovered that he had a lacquering machine with a transformer neatly hidden under a bench, practically defying detection. This was brought to his notice and he laughingly admitted that he used it sometimes but he didn't think it would make any difference. From that time on he was paying for sixty horsepower and

in two or three months the system is paid for.

Another case which came to my attention was a concern that was paying for seventeen kilowatts. After the installation of a maximum demand instrument this was shown to be thirty. The customer at once launched a very vigorous protest but after careful examination of his plant we finally found out he had installed a ten-kilowatt transformer and was using this periodically for heating purposes. This was raised to thirty kilowatts and the system benefitted accordingly.

Another case that came to my attention was where a customer's maximum demand was assessed at sixty horsepower. Once in about three months time he had occasion to use a motor. Under the ordinary method of assessment this was never found and consequently the customer was getting away with thirty-five horsepower maximum demand and the system was losing that amount of money. The maximum demand instrument picked it up and thereafter he paid accordingly. It was shown that he used it about half past four in the afternoon, which really was the worst time he could choose.

I bring these three examples of what we have found by the installation of these instruments to your attention. I think the day is coming when this method will be adopted to determine the maximum demand of all customers, even residential loads.

I think Mr. Lincoln has gone far to solve the question of a competent method of measuring maximum demand and I wish him every success in his further work. (*Applause*).

Mr. P. A. Borden: (H. E. P. C.). I have followed the development of this meter of Mr. Lincoln's with considerable interest ever since it has appeared in Canada, but it has been a great pleasure to be able to listen to the father of the instrument, and hear him explain in his own terms just what it represents. I have listened with great interest to his paper and in looking over it I have made a few notes on it which may or may not be of interest; possibly you will bear with me while I present them.

One statement made by Mr. Lincoln was that the user is not responsible for low voltage on his system. Well, primarily the user is not responsible for low voltage, but going right to the root of the matter it will be found that the responsibility must go partly to the man who pulls the voltage low. The Utility cannot supply an infinite amount of copper and the system have perfect lines any more than the customer can stop transformers and other equipment from heating. It would seem therefore if we are going to base the demand on the limitation of the Utilities' equipment as determined by heating, we would also be justified in basing the demand on the man who pulls down the voltage. In Ontario it would be difficult to proportion the responsibility exactly, but I think it should have some consideration.

In referring to the three recognized types of demand meters, Mr. Lincoln previously mentioned some methods of determining demand, then he said that there were three types of demand meters. Between two of these we have a compromise which is not a pure guess. The use of the graphic

watt-meter for determining demand is very common. In some graphic meters the pen moves very rapidly. In a perfect one the movements of the pen would exactly represent the load, but that would mean you would have a very much blurred chart unless it was running at abnormal speed and it would not be possible to read the chart. We have a large number of graphic meters in which the pen doesn't exactly show the load but only approximates it. Supposing the chart were a perfect representation you would then have the possibility of personal error in reading the chart. One man would say that shows a certain amount, and some other man would say that it showed a different amount. This would mean a controversy that could only be settled by the men getting together and reading it and arguing the matter over the chart itself. It seems to me on the sustained peak demand we are hardly justified to use the graphic meter. When you take your chart from that meter your percentage of error may be from five to fifty. The need is becoming more and more pressing for a meter which will actually measure demand and not only give us material from which we may guess.

Mr. Lincoln has stated that the heating is due to the limitation of our equipment. It would seem so as far as electrical equipment is concerned; we have it on the transformers and to a certain extent on the line and then taking into consideration the power plant, we have turbines, penstocks and the buildings and a lot of other things which represent it. The question is therefore, the heating, that is the kilovolt amperes, or the power, (which is watts) is the more consistent of the two upon which to determine the demand. In the determination of heating we know heating is not produced by the volt amperes carried on the system. In the case of a transformer, heating is produced by the heating of iron, a certain amount due to voltage and heating of copper. It would therefore seem that if we wish to use heating as a basis the proper thing would be to have some kind of a meter which would measure—not watts, not amperes, not volt-amperes, but a compromise consisting of some portion of the volts and some portion of the amperes. That would involve a machine which would be too intricate; that is entirely a theoretical consideration.

Mr. Lincoln states here: "Actual tests with meters of various types and on various time periods on loads of various kinds would be highly interesting." It has been my privilege to take part in a number of such tests which we have been carrying on during the past year or so, and the results have been most interesting. We used the thermal storage meter, the mechanically lagged meter and the block interval meter on four different time periods, and beside that we had a very complicated meter, which we had built up; this measured actual arithmetical average, and these we put on services with different loads. I wouldn't have time to go into the details of what the results were. You can readily understand that they were rather complicated, but very interesting; they will probably be published later. I might mention a few of the distinct points in connection with these tests. I was asked to carry out

these tests to a much greater extent but I found that the results were so uncertain—we had such variations in the readings that came in—it made so uncertain, we had such variations in the readings that came in, it made it apparent there was no use of going further. We noticed that the Merz or block type of meter and the thermal type of meter generally stayed pretty close together in their readings; the thermal meter, as might be expected, reading a little lower owing to the ninety per cent. characteristic.

The mechanically lagged type, with which you are familiar, the Westinghouse type "R.O.," showed rather peculiar characteristics and seemed to be affected by different time periods more than the other types. I mean to say the other types were not greatly changed by using different time periods, whether it was a five or thirty minute meter, the difference was not great. This shows that demanding high accuracy of the time period in any of these demand meters was quite out of the question. It was shown that the difference in the readings as regards time periods was negligible. The mechanically lagged type of meter showed a distinct tendency to read lower on long time periods. It showed with a load which continued along and then had an upward turn and then continued along with another upward turn, that the readings seemed to be considerably higher, that is their arithmetical average; whereas, with a load that went downward it gave lower readings, showing that this type of meter was very sensitive to changes in load which would not seem to have any actual effect on the heating of the equipment.

Mention was made a few minutes ago of the necessity of securing a meter that would show the exact basis on which demand should be assessed. This would be very difficult even with an ideal meter. The ideal meter I don't think will ever be produced, and I don't think it is necessary to endeavor to produce it. The tests that we have made go to show, I think I may safely say, that if the logarithmic meter is not the absolute ideal meter, it comes as closely to the ideal as any that can be obtained today and I think it approaches as closely to the ideal as any we may ask for. *(Applause).*

Mr. O. M. Perry: (Windsor). The Lincoln Demand Meter is on the market, I understand, for voltages up to one hundred, two hundred and five hundred, but the ampere coils are only for five amperes. Is there any reason why the meters could not be made self sustaining for larger amperages and thus eliminate the transformers?

Mr. Lincoln: We have that in view now and we expect before many months have passed to bring out meters with higher ampere capacities, say, up to twenty-five or fifty. The difficulty in that connection is that when the leads are brought into the meter of larger capacity than that, you have to face the problem of getting the heat conduction out of the leads, and that is rather difficult to handle. When you go above twenty-five or fifty amperes that problem becomes so difficult that we find it preferable to use transformers. We can say, however, that it will not be very many months before we can give prospective users

of this meter something considerably higher than the five amperes now available.

MR. LEE: May I ask if we can hope for something along the lines of a thermal storage meter for direct current?

MR. LINCOLN: I will say that is a question I have given considerable attention to and have never yet been able to get a scheme that was satisfactory to me. One of the reasons I just mentioned about getting the heat conduction out is met in dealing with this problem. The heat conductions are so severe it is very difficult to take care of. The only meter that I know of used for this purpose is called the Reason Meter that I have mentioned already. I have never made any test of this meter but I have seen it described many times; it is a device that has beeen used abroad. I don't believe there has been a Reason Meter used in Canada or the United States—I never personally saw one in service, but I understand the meter is considerably used in England and other foreign countries.

I don't personally consider that a very serious question, because I am looking forward to the time when there is not going to be direct current. I believe that direct current will not advance in volume as compared to the number of alternating installations. I look forward to the time when direct current installations will be a thing of the past and the time that everything done by it will eventually be done equally as well with alternating current. The great advantage is in distributing alternating current. I think when that condition does come the direct current will be pushed off the map. I therefore have not considered it a very serious problem. We believe if we solve the problem of demand meters for alternating current that we will have done sufficient. If any of you fellows with direct current come around and ask us about a meter we will say: "Well, if you change over to alternating current you will be all right."

MR. PERRY: I think this Convention is greatly indebted to Mr. Lincoln for coming here and giving us this most interesting paper.

I have very great pleasure in moving a hearty vote of thanks to Mr. Lincoln and I wish to include a vote of thanks to Mr. Mickler for the excellent paper he gave us this morning.

MR. R. T. JEFFERY: (H. E. P. C.). Mr. Chairman, before seconding that motion I wish to make a few remarks in connection with meters in general.

The basic principle of the whole Hydro scheme is to supply power at cost. That isn't as easy a proposition as it sounds. The Commission has solved that proposition I think fairly well as regards supplying power at cost to municipalities, but power at cost should also be supplied to both lighting and power users.

The cost of power depends on two factors, as has been stated already, and that is the maximum demand and the kilowatt hour consumption, or load factor. It has proved to be a very easy matter to measure the consumption kilowatt hours, but the measurement of the maximum demand under suitable commercial conditions is more difficult. For large loads the matter of maximum demand can be handled by installing graphic meters, and those meters are now

fairly accurate. We have pretty well weeded out a lot of the inaccurate ones, and the Commission so far as it is concerned, is only using such graphic meters as it considers to be commercially accurate.

For small loads it is a more difficult matter, not from a mechanical

standpoint, or an electrical standpoint, but from a financial standpoint. It is out of the question to install graphic meters at a cost of two or three hundred dollars on a load of, say, fifty horsepower, and the Commission for several years has been looking for a suitable meter to measure maximum demand on small loads from thirty to one hundred horsepower. We have used the Esterline meter which five or eight years ago was considered as good as one could get for that purpose; there was the "R.O." meter and for certain reasons we are not using that now. One reason was it cost too much money and on certain loads it is not accurate, and it requires more or less expert attention both in installing it and also in maintenance. We have been hunting and are still hunting for better meters to measure maximum demand. Our Laboratory tells us that we have now found what they consider to be the best meter that has been placed on the market for this measuring of maximum demand, and that is the Lincoln Meter. They consider it to be as near a perfect meter as any meter that they have yet been able to find and experiment with, and on the basis of their report and our own common sense and the basis that is included in common sense (the financial end of it), the Commission has placed an order for a considerable number of these meters which are now available.

The matter now comes down, as I see it, to the point of the loads on which the municipalities can afford to install these meters, or loads on which from a standpoint of justice, or supplying power at cost, or the standpoint of revenue, they should be installed on.

There is one point still unsolved, and that is where a customer is billed on a connected load and he may have a fifty horsepower motor installed and use perhaps half of that. If you don't put some kind of a meter in to measure the power how are you going

to bill him rightly, and that is the point which we have to work out now —to perfect the measurement of power used by small consumers.

I have very much pleasure in seconding Mr. Perry's motion.

THE CHAIRMAN: I have very much pleasure in presenting to you the Convention's vote of thanks.

MR. LINCOLN: I appreciate your expression of thanks, very much.

On that matter of power factor, it is a matter which I have given a great deal of attention to in the last four years, looking for a solution, because I have realized that the question of power factor, particularly on the small loads you speak of is very important. I have realized that there is a limit that can be spent for meters and that limit is rather quickly reached, but I can't see a solution coming. I don't say that such a meter can not be made but I do not see how it can be made at the present time. We can make you a graphic meter but it will have all the drawbacks of a graphic meter. When it comes to a meter for a load of twenty or thirty or forty horsepower, I doubt whether there is anything in the air at the present time which looks to a solution cheap enough so you can afford to put the meter on an installation so small as that. On an installation such as that the revenue is limited and not sufficient, as far as I can see, to stand the expense. That is the view I get now. We hope that condition may change. We are going to keep on thinking about this matter, but I don't see any immediate prospect of reaching a solution for that problem.

There is one point I would like to mention in connection with Mr. Borden's remarks; he mentioned that it was power capacity of the plant, the penstocks and amount of water used, and so on, that had this influence upon the cost of supplying this as well as the customer's own installation, which is all perfectly true. I would like to call attention to the fact that the amount of the equipment which is used at the customer's premises is generally of a higher order as regards expense of the equipment which is put in at the power plant; that is, are aggregate of all the equipment put into the customer's premises is as a rule considerably more than the equipment that is put in to serve them. The reason for that is that equipment put in for customers is always in smaller units; it is a matter of one, two, three, five, ten, twenty or fifty kilowatt transformers and motors, and you all know, when you get equipment in small units the aggregate cost is a great deal more than if you get it in very large units. I have seen examples of that. One example that is in my mind is the plant of the Chicago Edison Company; I have forgotten the figures but I remember being struck at the time by the fact that the aggregate of the installations which were put in at the customer's premises was very much larger than of the equipment back of that necessary to serve it, including the distributing system, the transmission system, all transformers and generators and engines and power plant—the aggregate of all of the equipment put in at the customer's plants was more than that which was put in at the power plant to serve it. The reason, as I just said, was because it was necessary to put it in

piece by piece, which was not the case at the power plant. That always will be the case. You gentlemen are in the public service and you are serving the public, and the aggregate of all the public is what makes up your total load and that consists of a great number of small units of equipment much more than is in your central plant necessary to serve them. This makes it important that the heat that is carried back to the power station must be taken into consideration.

I just wished to draw that to your attention. If you never had a chance to make an analysis of how much the customers' equipment cost as compared to the power plant equipment, you will be really astonished to find what the aggregate of all the customers' costs of equipment amounts to as compared with the cost of power plant equipment.

Dark Walls Waste Light

The color selected for walls and ceilings has a decided effect upon the lighting of rooms and upon our light bills. Even where the darker shades are used for artistic or other reasons, information as to the exact value of each color to reflect light is useful.

The illumination required in a room depends largely upon the amount of light absorbed by the walls and other surfaces. Dark surfaces absorb light, while light surfaces reflect a good proportion of the light back into a room. If the source of light is not changed, the effective illumination will vary with the reflection factors of the surfaces in the room. If, on the other hand, it is desired to maintain a fixed intensity of illumination, then the amount of light reflected by the walls on which the different colors are used will be in the following percentages of the light used: Enameloid, white, 80; flat tone, white, 79; flat tone, ivory white, 76; flat tone, cream, 71; enameloid, ivory, 64; flat tone, buff, 59; enameloid, pink, 51; flat tone, tan, 37; enameloid, tan, 27; enameloid, sky blue, 31; enameloid, cardinal red, 27; flat tone, forest green, 21; enameloid, wine, 12; enameloid, grass green, 10.—*L. G. Denis.*

Canada is the largest Dominion in the British Empire. It is larger in area than the United States, including Alaska, by 111,992 square miles.

Canada has the largest consecutive wheat field in the world, approximately 900 by 300 miles.

Ranney's Falls Power Development

THE Central Ontario System of the Hydro-Electric Power Commission is served from seven generating stations on the Trent Canal System. These are as follows: Dam 2, above Trenton, 5,600 H.P.; Dam 5, at Frankford, 4,800 H.P.; Dam 12, above Capbellford, 5,000 H.P.; Healey Falls, about one mile above the Junction of Trent and Crow Rivers, 16,800 H.P.; Auburn, at Peterboro, 2,750; Fenelon Falls, at the lower end of Cameron Lake, 1,000 H.P. The Commission also buys 1,000 k.w. from the generating station operated by the Corporation of Campbellford, at Dam 12. The total capacity of these plants is 37,390 H.P.

There are about twenty-five municipalities served by the Central Ontario System, including practically all the municipalities in the territory between Whitby and Kingston and extending North to Lindsay. The transmission system connecting these municipalities is shown in Figure 1.

The demand has increased in these municipalities so as to absorb the surplus which became available due to the closing down of munition manufacturing plants and, in order to provide for the immediate future, it became necessary to increase the generating capacity of the system.

Ranney's Falls at Dam 10 on the Trent Canal System being the most economical location available both in regard to construction cost and distance of transmission, it was decided to build a station there in 1920.

Ranney's Falls is situated on the Trent River, about one mile below Campbellford. (See Figure 1). It is located between the Campbellford Power House and future development at Dams 8 and 9.

The total difference between the regulated levels of the reach above the dam and the lower reach is forty-eight feet. The effective head on the plant will be forty-seven feet. In winter the water on the lower reach is frequently lowered about seven feet giving an effective head of fifty-four feet under such conditions.

The Dam was built by the Dominion Govenent as part of the Trent Canal System. Provision was made for power development by placing five sluice-ways each twenty feet wide, in the canal wall on the river side above the locks.

The development begins at the river side of sluiceways. Gravity retaining walls will be built, extending about 120 feet to the gate house, in which will be located the racks and headgates. Provision will be made for an ice-run in the head works. Very little trouble, however, is anticipated with ice, as there is slack water in the upper reach.

The gate house, power house proper and transformer house will be of reinforced concrete construction.

There will be installed two 5,000-H.P., single runner, vertical-shaft turbines, operating at forty-seven feet head at 120 r.p.m., direct-connected to the generators. There will be two Stoney sluice-type head gates for


LAKE
ONTARIO
KEY
Generating Station
Transformer Station
Switching Stand
CENTRAL ONTARIO SYSTEM
DIAGRAM OF
TRANSMISSION LINES
HYDRO-ELECTRIC POWER COMMISSION
REVISIONS

Figure 1.

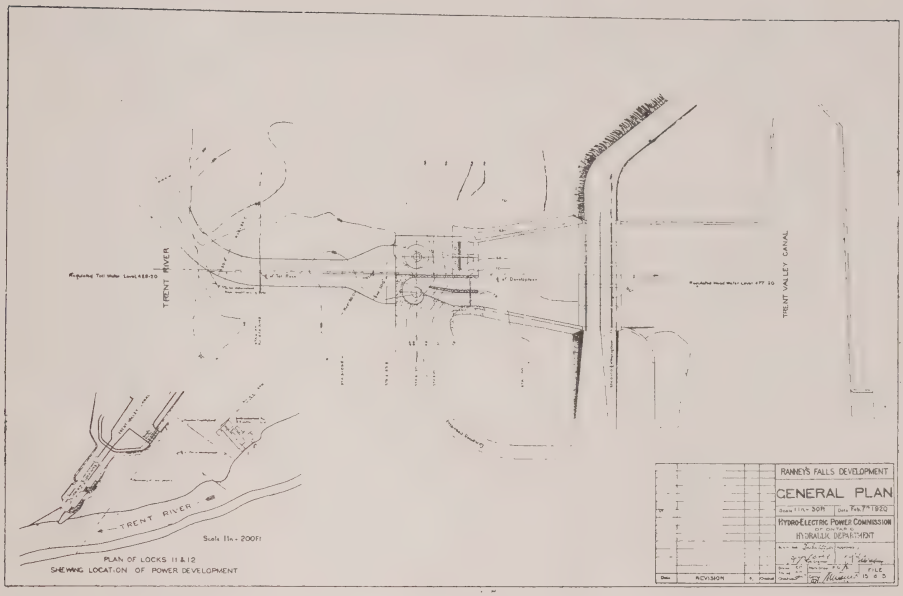


Figure 2—General Plan of Power Development.

each unit. The feeder pipes, and turbine casings are to be reinforced concrete.

The tail-race will be about 250 feet long extending from the power house to the lower reach of the canal. Except for a small amount of dredging in the river at the tail-race outlet, the work will all be in the dry.

Figure 2 shows the site in relation to the canal. Figure 3 is a section through No. 2 unit. Figure 4 is a

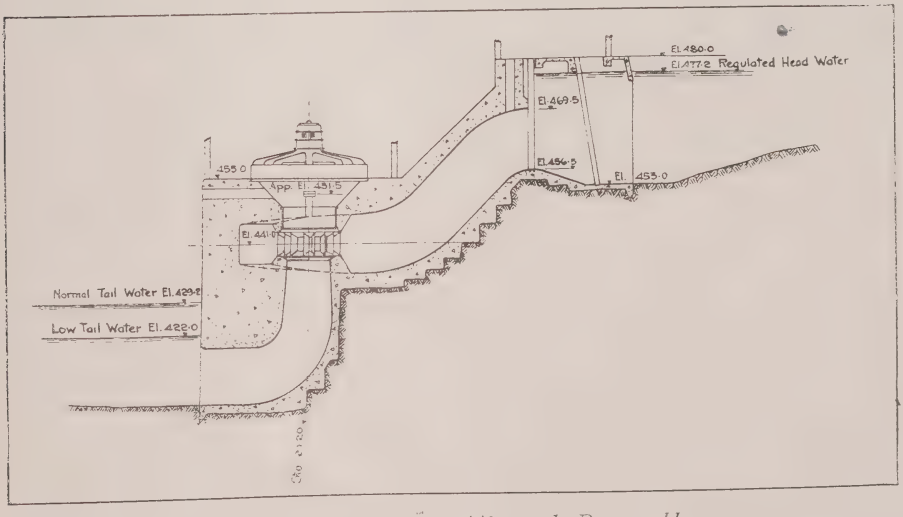


Figure 3—Cross Section Through Power House.

Figure 4—Ranney's Falls—General View of Power Development Site before Construction.

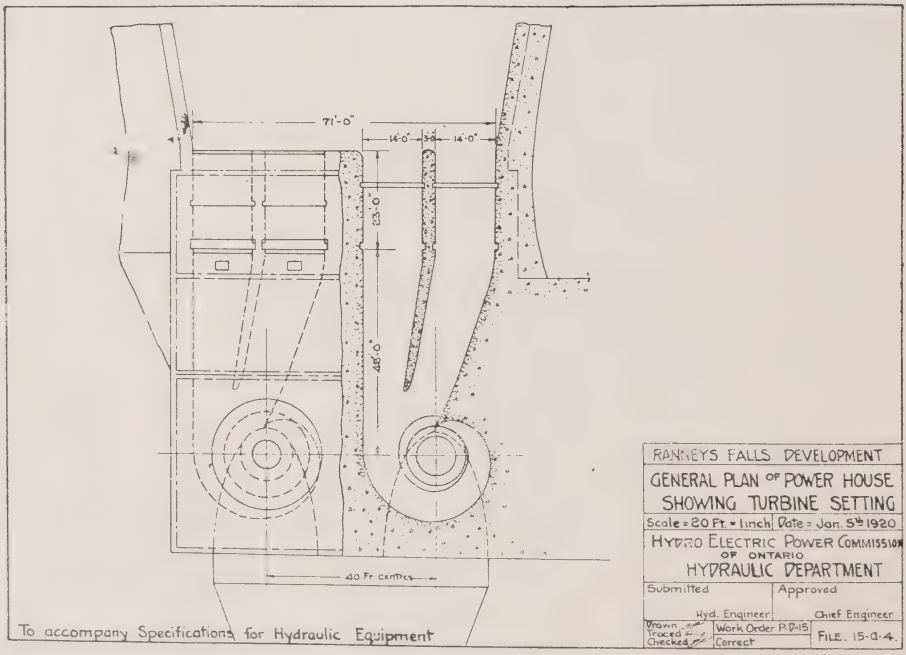


Figure 5—Plan and Section Through Power House.

photograph of the site. Figure 5 is a plan of the turbine setting.

The two generators will be of 4,500 k.w. capacity at 80 per cent. power factor with a continuous overload capacity of 5,300 Kva. These machines are 6,600-volt, 3-phase, 60-cycle, 120 r.p.m.

The exciters, rated at 50-k.w. will be mounted on an extension of the main shaft above the generators. A 50-k.w., motor driven exciter will be installed as a spare. Generating equipment is being supplied by the Canadian General Electric Company, Ltd.

There will be two outgoing circuits at 44,000 volts, one tying in to Line R and the other to Line G. This latter will be erected on the pole line which carries the tap to the Pulp Mill (See Figure 1). Service to the Pulp Mill, operated at this point by the Commission, will be at 6,600 volts.

Future developments at Dams 8 and 9 will probably feed into this station at 6,600 volts.

The construction will be carried out by the Construction Department of the Hydro-Electric Power Commission and the plant is expected to be in operation early in 1921.

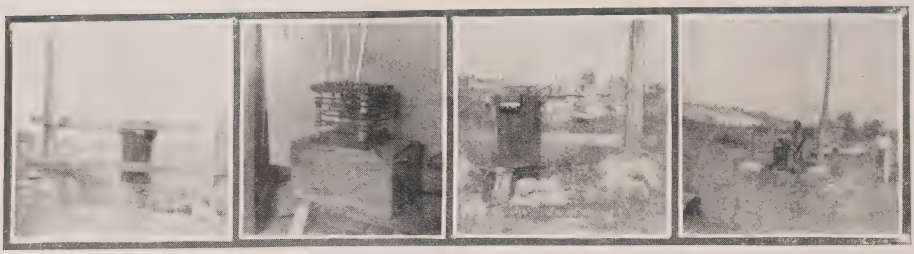
Hydro Used for Treating Poles

By F. C. Adsett,

Local Manager, Hydro-Electric Power Commission, Trenton

THE heating of small wood preserving plants *à l'electric* instead of by an open wood fire has proved an economy both in labor and in preservative. This is due largely to the low fire risk of the electric element. The practice of brush-treating or spraying poles with hot preservative undoubtedly would be more general to-day but for the difficulties and risks involved in the heating of the highly inflammable hydro-carbon wood preservatives in a pole yard with no proper facilities for doing such work. Using the electric element there are the additional advantages that the liquid is kept free from ashes, the apparatus is always ready for immediate use, and no attendant is required to devote all his time to watching the fire. To be most economical of course the power should be used "off peak."

That the creosote heating apparatus used at Trenton is entirely original may be seen in the accompanying illustrations. The heating element was made from obsolete laundry-iron elements arranged in series-parallel on a slate base. The element is bolted into the bottom of the tank and is provided with a guard to prevent the ladle from striking any live connections. With three porcelain transformer cut-outs connected as shown in the diagram the heat may be controlled by using 2,000, 1,000 or 500 watts. As only two plugs are supplied it is impossible for an operator to put a "short" on the service by



Views of Pole Treating Operations at Trenton.

plugging-in wrongly. For the tank, a 15-k.w. transformer case was picked out of the scrap heap; its capacity is 18 gallons. The service wires crossing the road to this apparatus are weatherproof copper, steel clad. The voltage drop in this wire will not permit the element to glow on the maximum current, a precaution that was considered essential to prevent the ignition of the preservative. Cut-outs at the top of the structure completely disconnect the service conduit from the line when not in use.

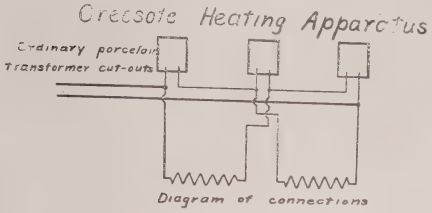
A measuring gauge is fastened to the tank, graduated to indicate the number of gallons contained therein. This permits a record to be kept showing the amount of preservative used.

In operation the current is turned on high until the liquid is sufficiently hot, then the plugs are changed to medium or low. The poles of course are peeled previous to being treated, and care is taken to cut away all the decayed wood. The preservative is dipped from a pail and brushed on the poles with a common white wash brush. A curve is given which shows the temperature range of a treatment during the first hour. No attempt is made to regulate the temperature by a thermometer in ordinary practice, the appearance of the liquid and its penetration into the wood is a sufficient indication of the heat. Two coats of the preservative are given to the lower eight feet of each pole, and to the gains and roof if it is possible to frame the poles at the pole yard. The preservative used is creosote supplied by the Canada Creosote Company, whose plant is in Trenton.

The temperature should be about 215° F. for the first application and about 175° for the second. The reasons for the higher temperature of the first coat are that all the heat obtainable is useful for killing wood destroying organisms, also, the higher temperatures open the wood cells and make the liquid more penetrative. It is well to bear in mind that the wood cells should be coated with the preservative and not necessarily filled; this condition is aided by high penetrability and means a more efficient distribution of the treating agent. The temperature of the various preserving compounds on the market will differ somewhat, each preservative having its most effective temperature.

It is interesting to note that a patent has just recently been given to the public covering the method of

perforating timber before treating, with holes systematically located at uniform distances apart. The depth of the puncture as well as the spacing will depend upon the kind of wood being used, because some cellular

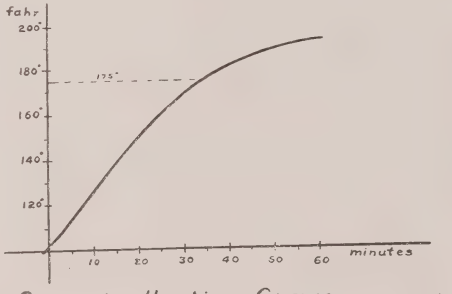


structures allow the preservatives to penetrate more readily than others. In the case of Douglas Fir the holes would be about ⅛ inch in diameter, ¾ inch in depth and would be made in rows every ½ inch around the pole, staggered 6 inches apart along the grain. If treated in an open tank about ten hours are required for a thorough distribution of the liquid to a depth of approximately one inch; when treated under pressure a shorter period will suffice. This process appears to be the most promising method yet brought out, but it might be too extensive for electric heating.

No elaborate cost system of pole treating has been kept but it is known that the consumption of creosote has been nearly ½ gallon per pole, allowing for two applications. The labor has amounted to approximately one man-hour per treatment, using inexperienced help. It is expected that this latter item could be reduced very considerably by working on a larger scale and piling the poles more conveniently. The penetration obtained is hardly measurable with any degree of accuracy, and varies with different kinds of wood. It is believed however to compare very favorably in cost with the impregnation of ½-gallon per foot of pole and a depth of nearly three inches as obtained under the high pressure and temperature processes that have been given to some of the hard wood poles recently purchased.

This heating apparatus has been used to treat timber for such jobs as transformer platforms, switching towers, etc.

Quite apart from this subject is the question of whether of not it pays to treat poles. The general consensus of opinion of those who have tried it is that the money expended has been well invested. The first hundred poles to be treated in this way are being numbered and a log is being kept of the kind of treatment, date put in, locality, etc. In some future number of THE BULLETIN the results may be recorded.



Creosote Heating Curve June 15/19

Plans for regulating the water of the upper Nile for irrigation are intended to provide the water necessary to enable both Egypt and the Sudan to develop their agricultural possibilities to the utmost.

New Administration Building Annex.

Administration Building Annex

OWING to the extremely congested condition of the Commission's Administration Building at 190 University avenue, Toronto, the Commission has recently purchased a reinforced concrete building located at the corner of Elm street and Centre avenue.

When the Administration Building was designed, the staff of the Commission was considerably less than one hundred, while, due to the Commission's unprecedented expansion, there are to-day nearly six hundred employees working in the Administration Building and in six separate dwelling houses on Murray street in the rear of the Main Building. Even rooms which were designed for meeting places of committees have been remodelled for use as offices, and no effort has been spared to cope with the expansion by devising new means of utilizing waste space.

Some time ago, plans and estimates were prepared, covering the erection of an additional building, to be located north of the Administration Building and fronting on University avenue, but present excessive building costs made it advisable for the Commission to acquire or lease a suitable building,

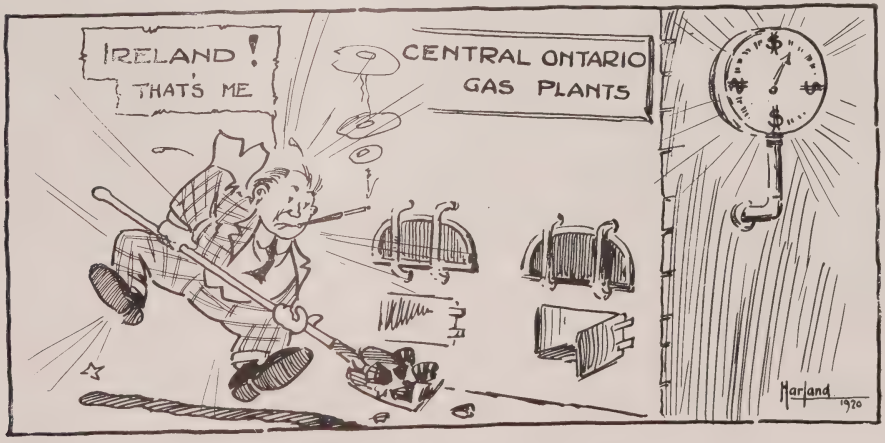
and, after careful investigation, the building shown on the accompanying illustration was purchased. This is located just two short blocks from the Administration Building. It was purchased at a comparatively reasonable figure, and when the Commission decides to add an additional building to the present Administration Building, it is the intention to utilize the Annex as a Garage and for such other miscellaneous purposes as the new building was originally intended.

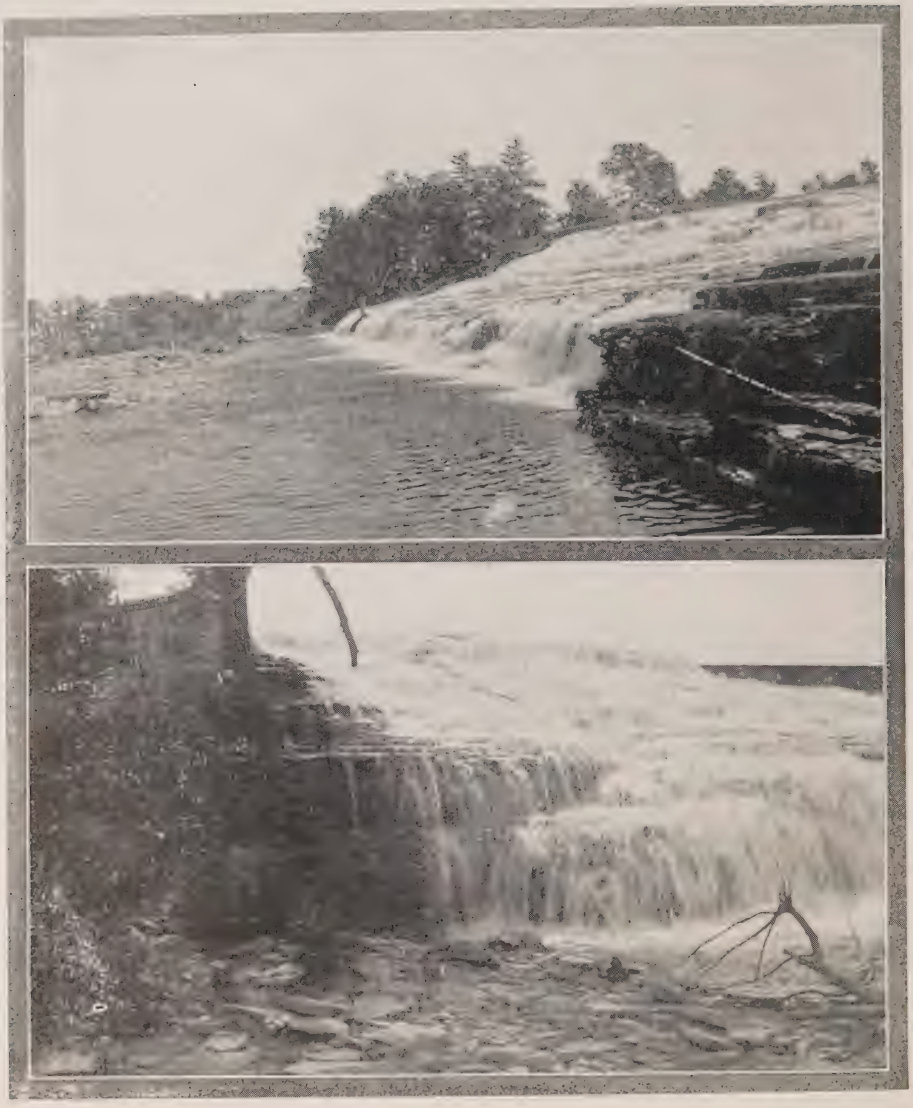
Misleading Reports about Water Powers

In an official report descriptive of certain areas in British Columbia, occur two references to Long river, tributary to McLeod's lake. One explorer characterizes it as "a large stream" with "an enormous amount of power," while the other explorer states that it is "a small stream" and that "there is not sufficient water to use this for power purposes."

An engineer of the Hydro-Electric Power Commission of Ontario was told by prospectors that the falls on the Kawashkagama river were capable of developing 30,000 horsepower at low water, and a surveyor assured him that the Kawashkagama would yield as much power as the Kaministikwia. Accordingly, the engineer undertook a hard journey to investigate but found only 317 horsepower instead of the 30,000 horsepower reported.

These instances demonstrate the great importance of accurate data respecting waterpower possibilities. It is also necessary that judgment be not formed on measurements taken during high-water stages. For this reason, the field engineers of the Commission of Conservation, engaged in compiling data for the report on "Water Powers of British Columbia," were not sent out when the streams were either at or near their flood stages. The effect was to curtail the season during which investigations could be carried on and thus to delay the publication of the report but, as over-estimates, occurring in an official report dealing specifically with water powers, would be particularly dangerous, it was a case where time had to be sacrificed to accuracy.





Healey Falls—View below Spillway.

Canada's field crop record, 1919, both in value of crops and acreage, was the highest on record. Value exceeded 1918 by $75,217,530, or five per cent., and 1917 by $303,517,000, or twenty-one per cent. The field crops yield of 1919 totalled more than a billion bushels of grain and over twenty million tons of hay and corn. It represented a value of $165.00 per capita, exceeding by $55.00 per capita the value of the United States crop of the same year.

Canada's farm wealth was estimated in 1917 to be $6,850,145,100.

The Organization and Work of the Laboratories

OVER two years have elapsed since the last description of the Laboratories appeared in THE BULLETIN. During that time the increased demands upon the department have made necessary considerable additions to space and equipment. The functions of the Laboratories have also been enlarged to include work which is essentially of a scientific or highly technical character. The present article will describe in general the work which is done by the department; future articles will enter in greater detail into the various phases of the testing and research work in progress at the present time and will describe features of the equipment and methods of testing which may be of interest and value to readers of the THE BULLETIN.

FUNCTIONS

The department was organized to serve all other departments of the Commission and to be at the disposal of the municipalities in all matters connected with testing and research. Its duties are to make tests on engineering materials and apparatus when requested by any department of the Commission or by any municipality, to carry on inspection of such materials or apparatus, to furnish data regarding the properties and characteristics of engineering materials and apparatus, and to carry out investigations in connection with problems arising in the design, construction or operation of the system. Its evolution has been a progression from a small beginning to the present organization which is equipped to conduct electrical, physical and chemical

The Service Building—one-third of the building—the portion in front—is occupied by the Laboratories.

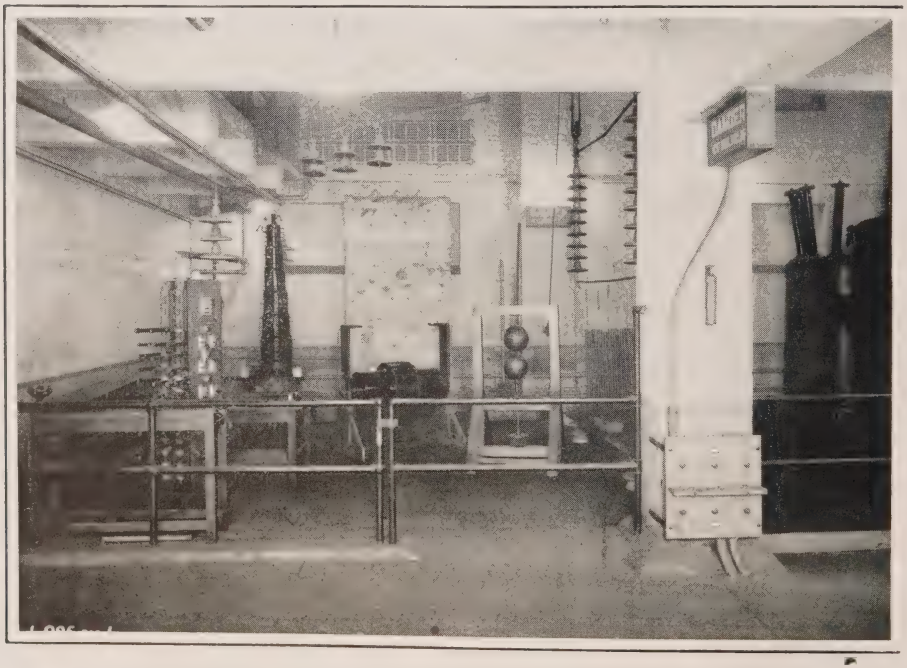
tests and to carry on extensive researches on engineering problems.

The testing and research work of the Laboratories is organized under two divisions, the Electrical Division and the Engineering Materials Division. The former contains the High Tension and Electrical Testing Laboratory, the Approval Laboratory, the Meter and Standards Laboratory, and the Photometric Laboratory. The Engineering Material Division contains the Structural Laboratory, and the Chemical Laboratory. The inspection work of the Laboratories is also carried on by this division.

Electrical Testing and Research

This work has increased greatly during the last three years, notably in the number of research problems which have been referred for solution by other departments. Tests are made on all kinds of electrical apparatus to determine efficiency, heating and other characteristics. These tests are made at the request of the engineering, sales and purchasing departments, and the information thus obtained is used as an aid in the selection of good materials for use on the works of the Commission and in the purchasing of supplies of the best quality obtainable for the municipalities which make use of the Commission's purchasing department. Among electrical supplies tested may be mentioned motors and transformers, heating and cooking appliances, electric washing machines, meters, lamps, insulating materials, wire, cable, transformer oils, rubber gloves, etc.

The electrical research work embraces a great variety of problems both theoretical and experimental. Theoretical studies have been made at



General view of the High-Tension

various times for the engineering department, in connection with line regulation, size of conductors for given loads, short circuit currents, voltage drop in electric furnace circuits, mechanical forces on busbars and disconnecting switches due to short circuits, division of load between sections of the high tension system and with many other problems arising in the design and operation of the system. Much of the research work also involves extensive experiments in the Laboratories. The following list will serve to indicate the scope of this work:

Lighting Protection: A study of the effectiveness of the protective apparatus in use on the system, and of the possibility of improvements.

Insulators: Investigation of high tension insulator troubles, new designs, methods of detecting defective insulators.

Transmission Lines: Most economical size of conductor, effects of tie lines on regulation and division of load, etc.

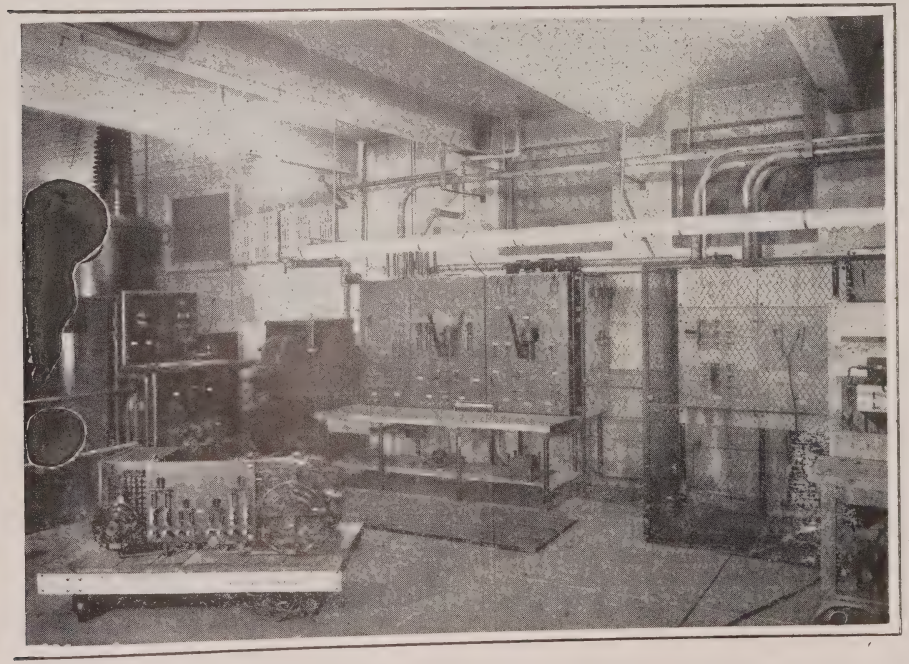
Maximum Demand: A study of the various methods of measuring the demand of power users and the development of instruments for measuring demand.

Incandescent Lamps: A study to determine the most economical efficiency, and life of lamps under present conditions as to cost of power in Ontario.

A more detailed description of the electrical research work will be given in a later article.

Approval Laboratory

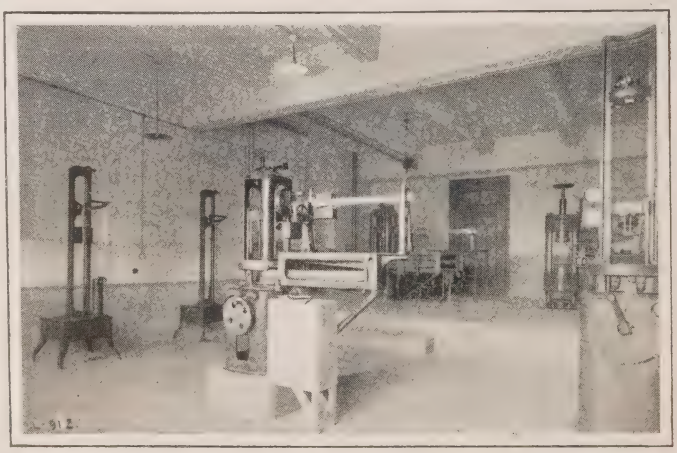
In accordance with the Electrical Inspection Act it is unlawful for any



and General Electrical Laboratory.

The Electrical Standards Laboratory, containing accurate meters, used to check the instruments carried by the Meter Inspectors.

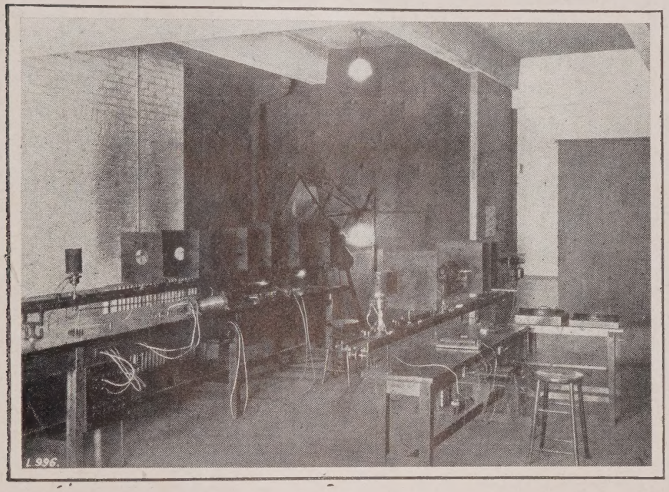
person to offer for sale in the Province of Ontario any electrical material, devices or fittings which may come under the inspection of the Commission, without constructing the same in accordance with proper standards of safety, and obtaining the approval of the Commission as to the design and construction of the same. The testing and inspection of such devices is carried out in the Laboratories where special equipment has been installed for this purpose. In this work the Commission has requested the co-operation of the electrical interests in the Province, which are concerned in this work, and has appointed an advisory committee containing representatives from the electrical manufacturers, jobbers, dealers, engineering societies, Board of Trade, Fire Underwriters, Municipal Electrical Utilities and the Canadian Electrical Association. This committee reviews and criticizes the reports of the Laboratories in all devices submitted for approval and assists in the preparation of standards and specifications for the construction of the same.



General view of the Structural Materials Laboratory, showing machines for testing the tensile and crushing strength of materials. A crushing force of 100 tons can be obtained from one of these machines.

Physical and Chemical Testing and Research

The testing work of the Engineering Materials Division embraces materials for line, station and power plant construction and includes all non-electrical tests on such materials. Cement and concrete materials, building stone, steel and other metals, transmission line hardware, cross arms, insulator pins, paints and rust proofing compounds, gasoline, lubricating oils, insulating materials, are regularly tested for the engineering, purchasing, operating and service departments.



Equipment used to test reflectors, shades and other auxiliary lighting devices—Photometric Laboratory.

The research work of this division includes an extensive study of the various sources of concrete building materials in the Province and of methods of proportioning and mixing to yield concrete of sufficient strength with a minimum of cement. A considerable mass of data has already been collected and is being used by the engineering and construction departments. The Commission has appointed a committee on concrete whose duties are to co-ordinate the efforts of all departments, to aid in co-operation among the Engineering, Construction and Laboratory departments, and to issue instructions regarding methods of selecting concrete materials for construction purposes. The Laboratory representative is chairman of this committee, and the Laboratory acts in an advisory capacity to other departments in connection with matters requiring tests or investigation.

This division of the Laboratories conducts inspection of all kinds of construction materials, such as steel for buildings, bridges, penstocks, and surge tanks, steel rails, pipe, etc. When a large amount of material is involved an inspector is sent to the factory from the Laboratory, but in case of small amounts of material or of jobs at some distance from Toronto, the Laboratory makes arrangements with an Inspection Company to do the work.

Photography and Blueprinting

The photographic and blueprint work of the Commission is done by the Laboratories. A complete equipment for this work is installed and a

great deal of copying, enlarging and reducing of photographs, tracings, etc., is done.

The official photographer also makes periodic visits to the largest construction jobs and photographic records of progress are made.

Miscellaneous Activities

The nature of the work performed by this department has resulted in the establishment of contact between the Commission and other organizations concerned with investigation and research. The preparation and revision of standards and specifications for the construction or purchase of engineering apparatus and materials involves methods of tests and technical questions which it is the duty of a department such as this to investigate. The Laboratories have been of assistance in this work through the representation of members of its staff on committees of various organizations in Canada and the United States. Members of the staff are now serving on committees of the American Society for Testing Materials, the American Concrete Institute, and the Canadian Engineering Standards Association.

Although the department was organized primarily to meet the needs of the Commission and the municipalities, its facilities are frequently made use of by firms outside the Commission. Thus the Photometric Laboratory makes tests on incandescent lamps for manufacturers and users; the Standards Laboratory repairs and calibrates voltmeters, ammeters and wattmeters of all types; tests have been made on motors, transformers, etc., for manufacturers to aid them in designing new lines. The volume of this class of work has increased greatly during the last two years.

This general description is intended to acquaint the readers of The Bulletin with the main features of the work of the Laboratories. The articles which are to follow will, it is hoped, describe the various activities of the department in sufficient detail to give an impression of the importance to the municipalities of the testing and research work of the Commission, and indicate how full advantage may be taken of the facilities here provided. The testing equipment and highly trained technical staff are at the service of the municipalities and of the public. If you have problems which involve testing, inspection, or investigation, an enquiry addressed to the Laboratories will receive careful attention.

Canada has 667,951 farms. Ontario has 184,337 farms; Quebec, 143,958; Saskatchewan, 103,912; Alberta, 67,603; Nova Scotia, 53,634; Manitoba, 49,855; New Brunswick, 37,204; British Columbia, 13,743; Prince Edward Island, 13,705.

THE COMMISSION
is a Member of the National Safety Council.

HYDRO MUNICIPALITIES

NIAGARA SYSTEM
25 Cycles

Acton	1,570
Ailsa Craig	462
Ancaster	400
Ancaster Township	4,577
Aylmer	2,119
Ayr	780
Baden	710
Barton Township	6,061
Beachville	503
Biddulph Township	1,750
Blenheim	1,257
Bolton	727
Bothwell	695
Brampton	4,023
Brantford	26,601
Brantford Township	7,739
Breslau	500
Brigden	400
Burford	700
Burford Township	3,882
Burgessville	300
Caledonia	1,236
Chatham	13,943
Chippewa	707
Clinton	1,981
Comber	800
Copetown	230
Dashwood	350
Delaware	350
Dereham Township	3,176
Dorchester	400
Dorchester S. Tp.	1,457
Drayton	613
Dresden	1,403
Drumbo	400
Dublin	218
Dundas	4,834
Dunnville	3,286
Dutton	840
Elmira	2,065
Elora	1,005
Embro	472
Etobicoke Township	5,822
Exeter	1,504
Fergus	1,679
Flamborough E. Tp.	2,229
Forest	1,421
Galt	11,920
Georgetown	1,654
Glencoe	831
Goderich	4,553
Grantham Township	3,133
Granton	300
Guelph	16,022
Hagersville	1,053
Hamilton	104,491
Harriston	1,563
Hensall	717
Hespeler	2,887
Highgate	427
Ingersoll	5,300
Kitchener	19,380
Lambeth	350
Listowele	2,291
London	57,301
London Township	6,024
Louth Township	2,212
Lucan	643
Lynden	662
Markham	909
Merriton	1,670
Milton	1,947
Milverton	929
Mimico	2,004
Mitchell	1,656
Moorefield	335
Mount Brydges	500
New Hamburg	1,398
New Toronto	1,423
Niagara Falls	1,715
Niagara-on-the-Lake	1,318
Norwich	1,093
Norwich N. Township	2,029
Norwich S. Township	1,907
Oil Springs	537
Otterville	500
Palmerston	1,843
Paris	4,437
Parkhill	1,239
Petrolia	3,047
Plattsville	550
Point Edward	937
Port Colborne	1,624
Port Credit	1,179
Port Dalhousie	1,318
Port Stanley	831
Preston	5,284
Princeton	600
Ridgetown	2,080
Rockwood	650
Rodney	626
Sandwich	3,077
Sarnia	12,323
Scarborough Township	5,525
Seaforth	2,075
Simcoe	4,032
Sprinfield	422
St. Catherines	17,917
St. George	600
St. Jacobs	400
St. Mary's	3,960
St. Thomas	17,216
Stamford Township	3,418
Stratford	17,371
Strathroy	2,816
Streetsville	500
Tavistock	974
Thamesford	504
Thamesville	742
Thorndale	250
Tilbury	1,605
Tillsonburg	3,059
Toronto	562,585
Toronto Township	5,008
Townsend Township	3,268
Vaughan Township	4,059
Walkerville	5,349
Wallaceburg	4,107
Waterdown	696
Waterford	1,027
Waterloo	5,091
Waterloo Township	6,538
Watford	1,115
Welland	7,905
West Lorne	708
Wellesley	583
Weston	2,283
Windsor	26,524
Woodbridge	615
Woodstock	10,004
Wyoming	526
Zurich	450
Total	1,167,251

SEVERN SYSTEM
60 Cycles

Alliston	1,237
Barrie	6,866
Beeton	588
Bradford	946
Camp Borden	.....
Coldwater	617
Collingwood	7,010
Cookstown	635
Creemore	599
Elmvale	775
Midland	7,109
Orillia	7,748
Penetang	3,672
Port McNichol	500
Stayner	990
Thornton	250
Tottenham	557
Victoria Harbor	1,542
Waubaushene	600
Total	41,941

WASDELL'S SYSTEM
60 Cycles

Beaverton	891
Brechin	215
Cannington	746
Sunderland	570
Woodville	357
Total	2,709

NIPISSING SYSTEM
60 Cycles

Callander	650
Nipissing	400
North Bay	9,651
Powassan	572
Total	11,273

MUSKOKA SYSTEM
60 Cycles

Gravenhurst	1,600
Huntsville	2,135
Total	3,735

EUGENIA SYSTEM
60 Cycles

Alton	700
Artemesia Township	2,396
Arthur	1,003
Chatsworth	286
Chesley	1,860
Dundalk	750
Durham	1,520
Elmwood	500
Flesherton	428
Grand Valley	586
Hanovere	3,310
Holstein	285
Horning's Mills	350
Kylsyth	.....
Markdale	904
Mount Forest	1,871
Neustadt	470
Orangeville	2,381
Owen Sound	11,819
Shelburne	1,018
Tara	620
Total	33,057

OTTAWA SYSTEM
60 Cycles

Ottawa	100,561

THUNDER BAY SYSTEM
60 Cycles

Port Arthur	15,224

CENTRAL ONTARIO SYSTEM
60 Cycles

Belleville	12,080
Bloomfield	523
Bowmanville	3,545
Brighton	1,278
Cobourg	4,457
Colborne	811
Deseronto	2,061
Kingston	22,265
Lindsay	27,752
Madoc	1,114
Millbrook	746
Napanee	2,281
Newburgh	444
Newcastle	600
Omemee	446
Orono	700
Oshawa	8,812
Peterboro	28,996
Picton	3,408
Port Hope	4,486
Stirling	823
Trenton	5,169
Tweed	1,350
Wellington	829
Whitby	2,902
Total	118,478

ST. LAWRENCE SYSTEM
60 Cycles

Brockville	9,473
Chesterville	868
Prescott	2,630
Williamsburg	100
Winchester	1,042
Total	14,113

RIDEAU SYSTEM
60 Cycles

Carlton Place	3,706
Perth	3,358
Smith's Falls	6,115
Total	13,179

ESSEX COUNTY SYSTEM
25 Cycles

Amherstburg	1,990
Canard Riveer	50
Cottam	100
Essex	1,429
Harrow	375
Kingsville	1,633
Leamington	3,604
Total	9,181

THOROLD SYSTEM
25 Cycles

Thorold	2,373

THE aim of The Bulletin is to provide municipalities with a source of information regarding the activities of the Commission; to provide a medium through which matters of common interest may be discussed, and to promote a spirit of co-operation between Hydro Municipalities.